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Hills of Southern Wisconsin Rich in Mineral Aggregates

Representative Plants of the District Visited and Described

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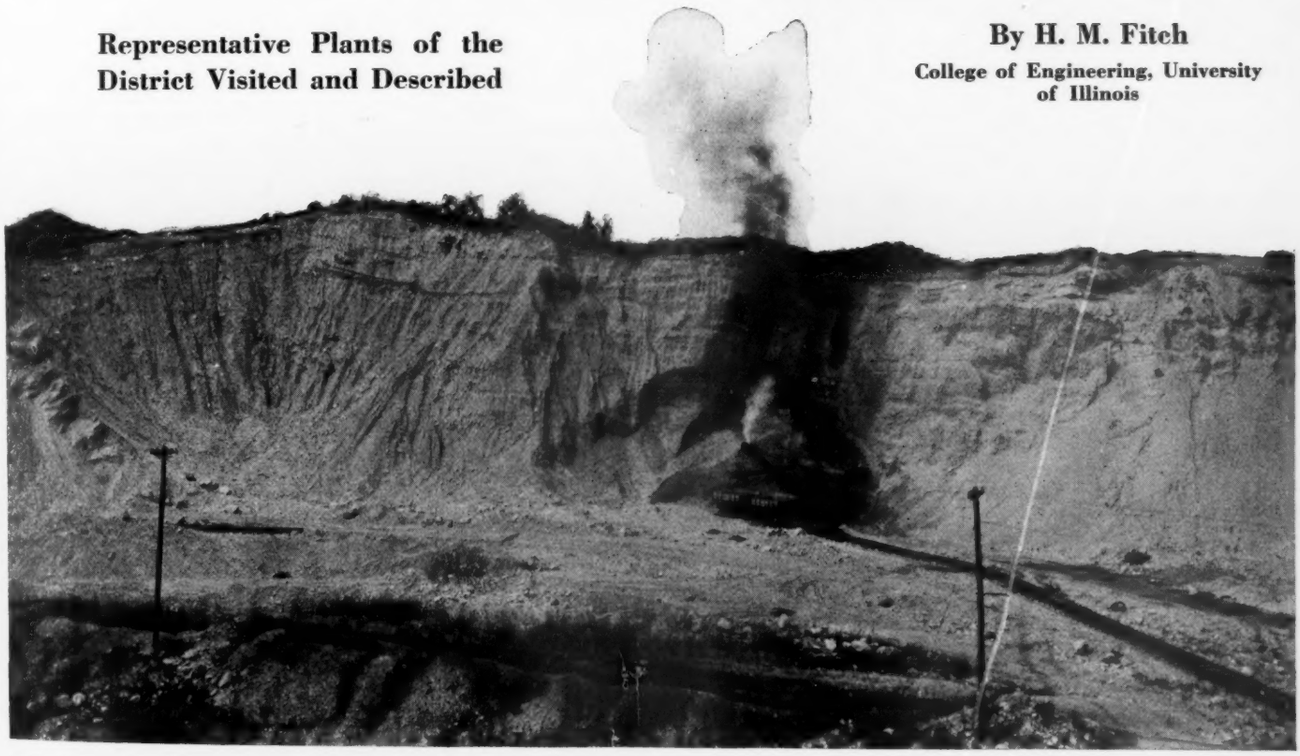


This happens to be the bank of the Northern Gravel Co., near West Bend. But it is typical of many spots in southern Wisconsin

ONE OF THE MOST INTERESTING PORTIONS of this country from the point of view of the mineral aggregate producer is the territory stretching across the southern ridge of the state of Wisconsin from Lake Michigan to the Mississippi river. Within this area are several stone quarries, an abundance of gravel plants (one may truly say a superabundance), as well as other types of rock products industries including several lime plants and at least one silica sand plant.

The eastern part of this territory is particularly productive, the area around Milwaukee, the chief city, being dotted with sand plants and quarries. These plants do not rely wholly on Milwaukee for their outlet, however, as there are many smaller commercial cities in the district, such as Racine with a population of some 75,000 and Kenosha with nearly 60,000, as well as many smaller towns which are steady users of mineral aggregates.

This whole territory is made up of a combination of active manufacturing towns and excellent farming communities, a rather unusual situation, but one which makes good roads a necessity and also promotes considerable general building activity. Some of the plants along the Illinois-Wisconsin state line ship their products to the Chicago area, some 50 or 60 miles away, but because of the long haul and the overcrowded condition of the Chicago market, this is generally not considered profitable.

As has been noted generally throughout the whole United States during the past two years, the building situation has not been good, and southern Wisconsin is no exception. In this territory gravel property is so abundant that almost anyone can open up a pit, and the consequent overloading of a diminishing market has worked a hardship on the stone and

gravel producers of the area. The history of many of the new "fly-by-night" concerns has been one of much opening activity, much long hauling and short prices, and a final passing out of the picture, only to be followed by other similar concerns.

Although no exact statistics are available on the amount of building going on in the territory, it is certain that the total has decreased steadily in the last three years. In fact many producers looked upon the outlet of their products for building purposes as practically nothing last season, and were it not for the continued activity in concrete road building in the territory, quite a number of the plants would surely have been shut down. As it is, the stock piles grew at nearly every plant, just to keep the operation in motion. Another reason for the stockpiling is that the producers are not getting diversified orders, but are finding an outlet for only one or two sizes, such as concrete stone, with the result that the other sizes which the plants are designed to produce must be stockpiled.

As mentioned above, a great portion of southern Wisconsin is so well supplied with gravel deposits that a pit could be opened almost anywhere. This gravel is practically all of glacial origin as the Wisconsin moraines covered, to a considerable extent, the southeastern portion of the state. The southwestern portion does not have the moraine gravel found to the east, and the gravel plants in this area are few and small in size.

Belt Conveyors Generally Used for Pit-to-Plant Transportation

In the eastern portion the gravel of the late Wisconsin glacial period was not moved any great distance; hence, the deposits are coarse and abounding in good-sized boulders. This means that crushing is an important factor at the typical plant and that a large proportion of the product is crushed gravel. Yet in spite of the fact that there are many large boulders in the deposits, many plants are being operated by pit conveyors instead of by a pit locomotive and dump cars. In fact this situation is so striking as to be well worthy of comment, since out of the dozen and more gravel plants visited, only one was using the pit locomotive, another was using motor trucks in the pit, and a third was a dredging operation. The balance all employed pit conveyors, some of them having only recently been changed over.

The reasons for such a change are obvious. A continual, even run of material to the plant is certainly more efficient for operation than an intermittent overload supply. At the same time it was stated by several superintendents that a saving was effected by the less expensive belt operation. Improvements such as those mentioned were more or less common in the territory throughout the past operating season. By installing these betterments the superintendents kept their men employed when orders did not warrant a full-time operation of the plant.

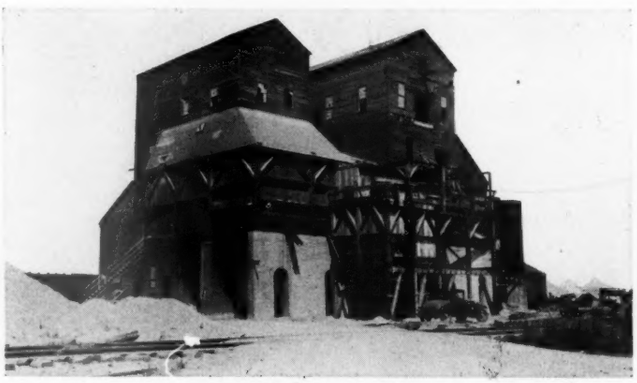
In visiting 15 mineral aggregate plants in southern Wisconsin, the intention of the trip was to visit typical plants throughout the area, or plants with some special feature which would make them particularly interesting to Rock Products' readers. New plants were not sought out, and, in fact, only one of the 1930 crop is here described.

Racine, Wis., Quarry

As a most convenient starting point, the trip outlined was commenced at Racine in the southeastern corner of the district, where the quarry of the Consumers Co. of Chicago was visited. This operation is not a new plant as it has been efficiently turning out crushed stone for years. The quarry is in the limestone strata which underlies a good portion of this district. Stripping varies from 2 ft. up to 15 ft., and is done by a 50-B Bucyrus dragline. The method used is to move the earth back from the quarry edge until a good-sized mound is built up all around the quarry and then a track is laid down on the bare rock and the earth is loaded and removed. Recently, the company has had the good fortune to be able to sell its strippings to the Milwaukee electric line which passes beside the property, for filling. The price, of course, was small but it paid for the removal. A 30-ton American locomotive is used in stripping work.

Drilling in the quarry is done with a Cyclone well drill, the holes being spaced 20 ft. back and 12 ft. apart. The holes run to a depth of 4 ft. below the quarry floor which means they vary in depth from 45 to 60 ft., the face of the quarry having that much difference from one side to the other. The load is 400 to 500 lb. of du Pont dynamite. Considerable secondary shooting is done, the drilling being done with Ingersoll-Rand jackhammers. Two Ingersoll-Rand 6- by 12-in. compressors supply air to the quarry. Du Pont 30% dynamite in 1-in. by 8-in. sticks is used for secondary shooting.

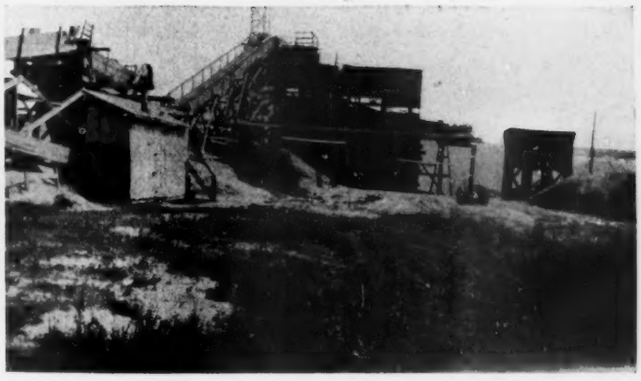
A real old-timer is being used for loading the stone in the quarry, as a 21-year-old Bucyrus 70 steam shovel is in steady operation. F. B. Padley,



Crusher house at Consumers Co. quarry. Plant No. 2 in foreground, with plant No. 1 just behind. Smaller washing unit in front

Quarry of Consumers Co. plant, Racine, Wis., where stripping varies from 2 to 15 ft.

Large stockpiles typical of conditions throughout the district at the present time



Big Bend Gravel Co. uses an exceptionally long conveyor from pit to plant

the superintendent, said it is still running perfectly and causing no trouble. The track system is circular, with two 18-ton Davenport locomotives moving the cars to the plant. A switch permits the locomotive to back the cars up to the ramp to be pulled up to the plant. The quarry trains generally consist of six 3½-yd. steel cars, although as many as ten can be used in a train if the plant is rushed. These cars are of interest as they are made by the company itself. The wheels are obtained from a manufacturer and the steel body is built at the plant. It requires about a week for two men to complete a single car.

A cable hoist pulls the cars up the incline to a hopper above a 36-in. by 60-in. Fairmount roll crusher, where an automatic tripper opens the end gate of the car for dumping. The rolls, operated by a 50-hp. General Electric motor, break up the larger pieces, and deliver the discharge to the boot of a 42-in. bucket elevator which takes it to the top of the plant. Here the stone is emptied to a bar grizzly which removes all pieces above 10 in. This larger stone is not recrushed but is kept separate and loaded directly to cars to be shipped to the Johns-Manville Co., a large user of this size stone. The material passing through the grizzly falls to a Niagara vibrating screen. This scalping screen was particularly installed to keep clay, which is sometimes found in pockets in the quarry, from passing through the plant and clogging the crusher. It has been successful in accomplishing this purpose, Mr. Padley stated.

The rejects from the vibrating screen are divided equally between two Gates No. 6 gyratory crushers. The discharge of both crushers is carried to the top of the plant again by a 30-in. bucket elevator and there joins the throughs from the vibrating screen as they enter two Allis-Chalmers revolving sizing screens. These screens were formerly 40 in. in diameter but have been replaced by 48-in. screens during the past year to increase efficiency. The sized material is carried by chutes to a row of Universal vibrating screens below the revolving screens, for additional refinement in sizing before dropping to the bins below. However, the screen discharge at this point may be diverted to a washing plant that has been installed at the plant during the past year. Because of an increased demand for washed stone it was necessary to build this washing plant, and the site chosen was directly beside the original plant so that it really forms an integral part of the whole layout. The demand for washed crushed stone has been so great that enlargement of these original facilities is already contemplated.

Water for the washing plant is supplied from an old quarry adjacent to the larger quarry now being worked. It is pumped to the plant by an Allis-Chalmers pump delivering 1000 gal. per min.

The rejects from the pair of revolving sizing screens drop to a pair of No. 4 Allis-Chalmers secondary crushers. The discharges of these two crushers are united on a conveyor which carries the stone to the second unit of the plant, called plant No. 2. This portion is similar in size and shape to the original plant, but was built some years later. It is immediately adjacent to the first plant and could be operated as a separate unit if something should go wrong with the machinery of the first unit. At the time the plant was visited, however, it was being run as an auxiliary to the main plant, and the only stone it received was the crusher discharge from the two crushers mentioned above.

The stone brought to plant No. 2 by the belt conveyor is carried to the top of the structure by a bucket elevator where it is delivered to a pair of Allis-Chalmers sizing screens. The throughs drop to the respective bins below, while the rejects fall to another pair of secondary crushers. One of these crushers is a No. 5 Austin and the other is a No. 4 Allis-Chalmers. The discharge is carried back to the screens by bucket elevator.

Stockpiling is done by a McMyler crane with a 1¼-yd. Williams bucket unloading regular gondola cars from the company's railroad tracks. The cars are moved by a 45-ton American steam locomotive. The company did considerable stockpiling during the past season because despite a good demand for certain sizes, other sizes have had to be produced for which there is little or no demand.

For the most part the company ships by rail, its orders going as far as Milwaukee to the north and occasionally Evanston, Ill., a suburb of Chicago, to the south.

"Hope Springs Eternal"

***THIS ARTICLE** is a survey of the mineral aggregate industry in one of the most over-planted areas in the United States.*

This area produces some of the best sand and gravel in the United States. It probably gets the lowest average price of any. Deposits are everywhere. New plants have been built promiscuously, apparently, for the character of the operations are very similar, as are the deposits, so that production costs cannot vary much.

With the decrease in general building the industry has suffered not merely from over-capacity, but actual over-production because of the unbalanced demand for special sizes. Huge stocks are accumulated.

Gravel plants, with one exception noted, ship more than ordinarily short distances, and practically only for highway work. The one exception seems to be peculiarly favored in the matter of low costs, so that it can ship up to 130 miles.

Quarries, with a few exceptions, have been practically eliminated from the picture. It is notable that in each case of a quarry operation some special product is made other than aggregates.

This article should prove helpful to the industry in showing that it requires a great deal more than a good deposit, economically and efficiently operated, to make a profit in this industry where the supply of raw material is as plentiful as here.—The Editor.

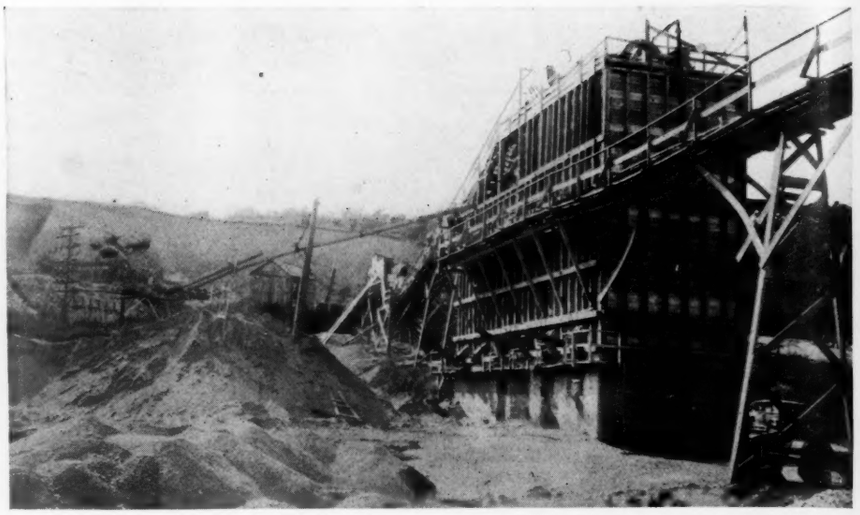
Big Bend Gravel Co.

Many of the gravel plants in the southern Wisconsin area are not large producers although they do turn out a steady output. A typical plant among the smaller producers is that of the Big Bend Gravel Co. at Big Bend, Wis., about 15 miles north of Burlington and on the extreme edge of the Milwaukee district. Of particular interest at this plant is the pit layout where a single belt of approximately 500-ft. centers delivers the material from the pit hopper to the plant. A steam shovel is used for loading in the pit.

The plant layout is of the usual type with the material passing through a revolving scalping screen and the rejects falling to a gyratory crusher below. The throughs are carried by a belt conveyor to the main washing plant where a jacketed screen sizes the material. A sand drag is used for dewatering the sand.

Stockpiling is done by the use of two small gondola cars on the company's trackage beside the plant. A Brownhoist steam railroad crane is employed for unloading the cars and also for car moving. However, the track layout has been so arranged that there is a "valley" immediately beside the plant bins so that the cars are automatically spotted beside the plant by gravity.

The Big Bend company ships both by rail and by truck, the former transportation being over the tracks of the Milwaukee electric lines. Overhead trolleys are installed over the tracks to the plant so that electric locomotives can bring cars directly to the plant. The electric railway, by the way, owns this pit and leases it to the gravel company. This hook-up is fortunate for the company as it has a contract to furnish a considerable amount of gravel to the line for various improvements. Such improvements include work on the large power plant at Lakeside and considerable tunnel and retaining wall construction in the Menominee Valley. The Big Bend plant is capable of turning out about 400 cu. yd. daily, and as indication of the steadiness of its production during the past season it is reported that it was several thousand yards ahead of its production for the same period of 1929.



Plant of Prospect Sand and Stone Co., showing high bank in brackground and stockpiling trestle at right

Prospect Sand and Stone Co. Uses Trucks in Pit

An interesting and rather unusual operation for the Wisconsin area was that of the Prospect Sand and Stone Co., at Prospect, Wis., some 18 miles from the center of Milwaukee. At this operation trucks are employed in the pit to move the material to the plant, a means of transportation rarely found in this territory. The gravel bank is in a bluff above the level of the plant, an arrangement which permits dumping directly to a hopper beside the scalping screen without any up-hill hauling. Hence the hauling from the face of the plant is practically all level which permits of easy and economical operation of trucks in the pit, whereas in other gravel layouts they would be entirely uneconomical. The gravel is firm and well compacted so there is no trouble in keeping the floor of the pit in condition for the trucks.

An Erie steam shovel is used for loading in the pit. The bank is high, having a face of some 50 or 60 ft. There is also some stripping to be done. The material in the pit is a good grade of gravel with a rather high percentage of boulders which require crushing.

The trucks in the pit dump to a bar grizzly of railroad rails above a hopper. The larger stones are here broken in pieces or else removed to one side. The gravel passing through the grizzly is fed to a belt by a reciprocating feeder and is then carried up to the scalping screen. The rejects of this screen drop to an Allis-Chalmers gyratory crusher driven by a 75-hp. Ideal electric motor. The crusher discharge returns to the first belt by means of another belt in a closed circuit. The throughs of the scalping screen are carried up to the washing plant on a 24-in. belt conveyor.

The material is delivered to a jacketed sizing screen having one blank scrubber section. The throughs of the jacket deliver the sand while the material retained by the jacket is the pea gravel. From the main screen is obtained ½-in. and 1-in. gravel, while the rejects of this screen are of 2-in. size. The sand is carried to a reciprocating sand drag beneath the revolving screen for dewatering. This drag, the revolving screen and also the belt from the scalping screen are all driven by the same Allis-Chalmers motor.

A wooden stockpiling trestle has been built at the eastern end of the plant. This carries a 16-in. belt which is fed directly from the bins. This trestle, however, does not incline downward near the plant to

Mayville operation, looking from upper quarry toward lower quarry and plant

Quarry face at plant of Waukesha Lime and Stone Co.

reach the bins at their bottoms, but instead remains at its high level throughout so that it is fed from the tops of the bins instead of at the bottom. This simplifies construction, since the structure is merely braced up by pieces set against the side of the wooden bins. Moreover it requires but one belt for the whole stockpiling trestle, instead of employing one on the slope and one on the level upper portion. And finally it permits trucks loading on the same side as the trestle, a thing which would be impracticable if the trestle were at the low level. The Prospect company ships entirely by truck, using chutes on both sides of its plant to facilitate loading. Most of its gravel is used in the Milwaukee district.

Waukesha Lime and Stone Co.

Although the Waukesha Lime and Stone Co. is an active producer in both of the main branches of the mineral aggregates industry, time permitted the visiting of only one of the plants and the quarry operation was chosen. The gravel operation is only across the road from the quarry, and, in fact, both plants are operated under the same superintendent.

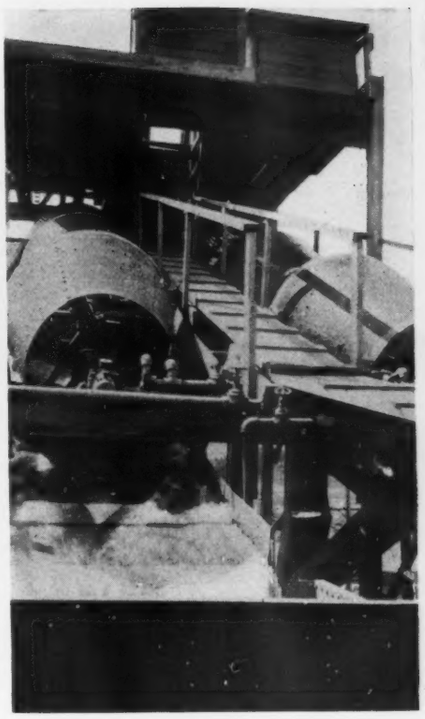
The Waukesha quarry is unusual in that it is very long and comparatively narrow. A single narrow-gage track runs to the shovel at the far end, and two Milwaukee gas locomotives haul the cars to the plant, a siding permitting the trains to pass by each other. Western side-dump cars in trains of two each are used in the quarry and they are loaded by a Bucyrus shovel.

This quarry is unusual in the definitely stratified limestone rock found here. So readily does the rock break into flat slabs when blasted that the company has found it advantageous to enter the field of dimension stone, taking some of the larger slabs after a blast and finishing them down to marketable pieces. Porch steps and slabs, water tables and window sills are some of the pieces produced. Several finishers' shacks have been set up right on the quarry floor and the pieces are worked to shape before they are taken from the quarry.

The quarry cars dump to a 40-in. by 60-in. Allis-Chalmers jaw crusher run by a 200-hp. Ideal electric motor. The discharge of this crusher is carried to the top of the plant by a 42-in. pan conveyor, operated by a 75-hp. Allis-Chalmers motor. Here the stone is deposited on a railroad rail grizzly which sends the larger stones to a pair of Allis-Chalmers gyratory crushers, each driven by its own Allis-Chalmers 50-hp. motor through a Texrope drive. The material passing through the grizzly falls to an Allis-Chalmers Newhouse crusher. The discharges of all three crushers unite at the boot of a bucket elevator and are carried to the top of the plant again.

The material is deposited in a triple deck Allis-Chalmers vibrating screen for sizing and the stone passing through this screen is further sized by smaller vibrators above the bins. A Symons cone crusher for recrushing gets its material directly from the bins. The discharge of this crusher is carried up by a bucket elevator and delivered to a pair of Galland-Henning vibrating screens in series for resizing.

A considerable portion of the stone at this quarry is dried and pulverized for special purposes. A 60-in. by 65-ft. dryer is installed in the pulverizing building beside the main plant. The material from this goes to a pair of Allis-Chalmers pulverators in a closed circuit with two "Hummer" screens. A 60-in. by 22-ft. Smidth tube mill grinds some of the stone to 200 mesh for use largely as asphalt filler. A Bates 4-valve bagging machine is used for sacking this material. A long shed at the south end of the plant serves as a storehouse for this material, and from this building the sacks are loaded directly to railroad cars.



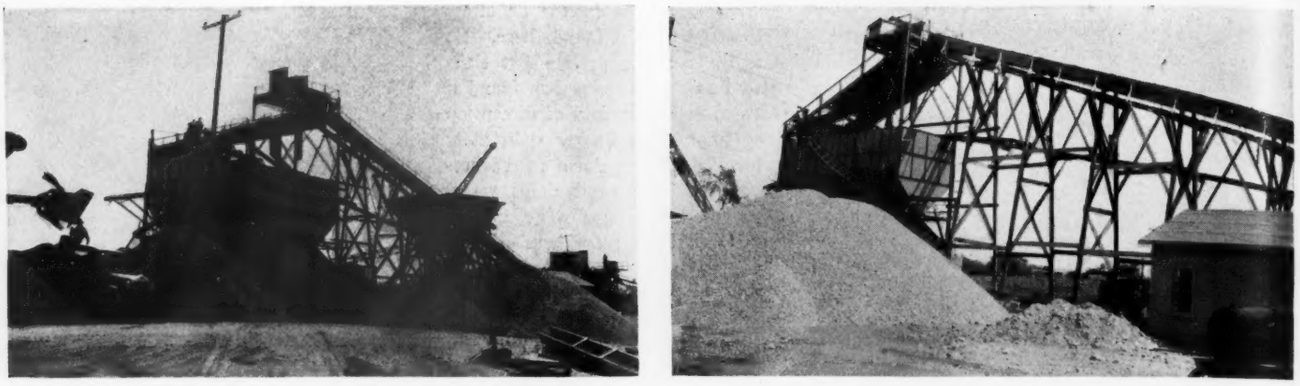
Washing and sizing screens at Brookfield plant of Waukesha Washed Sand and Gravel Co.

Cutting porch steps from stratified slabs at the Waukesha quarry. Clarence Wolf, superintendent, standing

Waukesha Washed Sand and Gravel Co. Has Four Plants

Two of the four plants operated by the Waukesha Washed Sand and Gravel Co. were visited on the trip. The newest plant of the company is the one at Brookfield, Wis., a few miles northeast of the city of Waukesha. The other plant visited was the large producer at Okauchee, about 15 miles northwest of Waukesha. The company's other two plants are located at Waukesha and at Madison, Wis.

The plant at Brookfield was placed in operation in the spring of 1930. The location is entirely new, but not all of the equipment installed is new, since the steel bins used were moved from another location where the Waukesha company had abandoned an operation. The company picked this particular site, about a mile west of the little town of Brookfield, and adjacent to the tracks of the Milwaukee railroad, because previous investigation



Brookfield plant of the Waukesha Washed Sand and Gravel Co.

and testing had indicated an exceptionally good deposit at this location. The tests showed the pit to contain about 80% gravel, a very high figure even for the glacial territory around southeastern Wisconsin where the banks generally show a high gravel percentage. The demand for gravel in the Milwaukee district, being considerably greater than any demand for the finer sizes, decided the Waukesha company to open this pit. Since opening the pit, it has been found that the whole deposit does not by any means reach the 80% gravel figure that was originally promised, but the percentage is good and the plant is operating satisfactorily.

The face at this pit is much less than the average pit face in this territory. This is not because of any lack of gravel at the lower levels, but the excavation has reached the water level and lower depths cannot be worked with the present equipment. It is possible that the company will install a dragline outfit similar to the one in use at the Okauchee plant, but a dredging operation is a more likely solution, according to Ed Reiton, the superintendent of the Okauchee plant, who has been directing the Brookfield operation while it has been getting under way. A dredging operation would be more advantageous at this location than at many in the territory since the deposit is much more uniform in size with very few large rocks.

At present the pit is being worked by a No. 55 Thew Lorain shovel with a 1-yd. bucket loading to a pit hopper which feeds the material to a short movable pit conveyor. A grizzly over the hopper keeps out the larger stones. The short conveyor delivers its material to a long 24-in. conveyor leading to the scalping screen at the plant. Dodge and Link-Belt idlers are used and the belt was manufactured by the Thermoid Rubber Co. The material passing through the scalping screen falls to another 24-in. belt which takes it to the washing plant, while the rejects drop to an Allis-Chalmers Newhouse crusher. A short conveyor carries the crusher discharge back to the pit conveyor to be returned to the scalping screen.

The washing plant is entirely of steel construction, there being three V-bottom Butler bins of 360-yd. capacity. The screens and dewatering tanks above the bins are supported on steel columns. The belt from the scalping screen brings the material up a wooden trestle and delivers it to two banks of conical revolving Toepfer screens. There are three screens in each bank, followed by a Telsmith steel sand tank for each bank. The rejects from each screen drop to the bin beneath that screen, while the throughs are carried on and delivered to the next screen. The throughs from the last pair of screens go to the two sand tanks. The first pair of screens produce 2¼-in. down to 1¼-in. material; the second pair 1¼-in. to ½-in. gravel, and the third pair deliver ½-in. to ⅜-in. pea gravel. The fourth size produced at this plant is the sand.

Water for washing is supplied by an Allis-Chalmers centrifugal pump delivering 800 gal. per min. Pumping is done from a pit adjacent to the plant, but it was found that when the required amount of water was taken from this pit it would run dry, so a second pit had to be prepared. A second Allis-Chalmers pump capable of pumping 400 gal. per min. was installed at the latter hole and used to pump into the first hole when occasion demanded.

The Waukesha company had not yet built a siding for this plant, although the property is adjacent to the Milwaukee right-of-way, when the author visited it. However, it was expected that tracks will be laid within a year. In the meantime the plant is shipping entirely by truck. The biggest part of its output has gone for a road construction job in the vicinity where seven miles of new concrete highway was constructed last year. The contractor set up his batching equipment beside the plant and employed his own crane for loading. The company does not operate any trucks itself.

The size of material which this contractor was taking did not coincide very well with the run of material from the bank, so that the company was up against the proposition of stockpiling some 400 cu. yd. of sand every day as long as the contractor was taking his material. This is somewhat greater than one-third of the plant's total output since its daily run is about 1000 or 1100 cu. yd. A drag scraper with its hoist located directly under the center bin was installed for stockpiling this sand, but with all the available space near the plant taken up already with large piles, the question has come up as to where the material can be piled next.

The Brookfield plant was mostly built by men from the Okauchee plant; thus during the off season the men were kept at work and were available when it was necessary to operate the Okauchee plant.

Okauchee Sand and Gravel Operation

The other plant of the Waukesha Washed Sand and Gravel Co. which was visited is by no means new, but it is of interest because of several of its novel features and also because it is a large producer and one of the steadiest producers in the territory. The pit arrangement at this operation is particularly interesting, since two distinct methods of getting the sand out are employed. The ground is first opened by a steam-shovel loading to the usual pit hopper and conveyor belt, but when the water level is reached by this method a cable-way excavator is set up and the pit is carried down for a considerable distance below the surface of the water.

The Okauchee pit covers a considerable area and is roughly rectangular in shape. The plant is located at one corner with a belt conveyor along the adjacent long side leading to the scalping screen from the far end of the pit. A Thew shovel digs directly across the far end of the pit, loading to the pit hopper in back of it. The hopper feeds the material to a short belt which delivers it to the long belt to be taken to the plant. This short belt, which is parallel to the end of the pit and forms a right angle to the long belt, is extended by adding more sections as the shovel

cuts farther across the pit. Although this necessitates the use of more than 2000 ft. of belt in getting the material to the plant, it has been determined that it is the steadiest and most successful means of transporting the material to the washer.

An unusual draining arrangement is used for the material delivered by the cableway excavator, which is a Sauerman Bros. outfit with a 1½-yd. bucket. This excavator works to a depth of 40 or 50 ft. and delivers the gravel to a large storage pile over an A-shaped wooden tunnel previously constructed on the ground. This tunnel contains a conveyor belt and is equipped with feeder gates to permit the material to fall to the belt. The conveyor empties to a hopper above the long belt previously mentioned and the material is thus carried up to the scalping screen. In operation, the excavator dumps its material to the pile at one end of the tunnel while the gates at the other end are opened to allow the dewatered gravel to pass to the plant. Then after several hours these gates are closed and the ones at the other end are opened, the excavator dumps to the opposite end, and thus the whole process has been reversed. The time permitted for the material to stand in the piles is sufficient for all the draining necessary. This arrangement also has another advantage, since the plant can keep on operating for hours from the storage piles, should the excavator machinery need repairs.

The washing plant is typical of the plants in this section. The material first enters a scalping screen where the throughs drop to a belt to be taken to the washer, while the rejects fall to a No. 5 Telsmith crusher. The Toepfer sizing screens at the top of the plant are enclosed in a large room above the bins. This arrangement is rather unusual for the average plant in the Wisconsin area, but is worth while, since it keeps both machinery and men out of the weather and thus speeds up production. The rejects of the sizing screens can be recrushed in a Gates gyratory crusher if desired. Two Telsmith automatic sand tanks below the screens are used for dewatering the sand. Bins to handle mason sand have recently been added. Plenty of clear water is furnished by pumping from the deep part of the pit.

Hartland Washed Sand and Gravel Co.

A few miles east of Okauchee at the town of Hartland is the plant of the Hartland Washed Sand and Gravel Co. Like the Okauchee plant of the Waukesha company, this operation also uses two methods of getting the gravel out of the bank—by shovel and by drag scraper. Likewise the material is transported to the plant by long conveyor belts.

The Hartland pit is irregular in shape and is also variable in the sizes of stone found. Near the plant where the drag line is at work the material is finely divided for the most part, but farther back in the deposit where the shovel is operating, the material is coarse with many boulders. From this deposit the conveyor passes through a real gateway to get out into the main pit and thence to the plant nearly a quarter of a mile away. Difficulty in obtaining all the property wanted adjacent to the larger pit made it necessary to cut this narrow passage through to this other tract which the company controlled. The pit face at this point is about 60 ft. in height.

A Koehring electric shovel loads to a portable pit hopper fitted with an 8-in. grizzly. From this the gravel is fed to a movable steel truss conveyor manufactured by the Northern Conveyor and Manufacturing Co. The end of this conveyor sets on a hopper above the end of a permanent 24-in. pit conveyor. Around the upper end of this hopper a steel hoop has been fitted on which the portable conveyor rests so that it can be easily swung around in a circle to follow the shovel as it digs. The first permanent conveyor is some 200 ft. in length and just reaches out through the gateway from the deposit. Here a right-angle turn starts the second conveyor off directly toward the plant. This one is some 500 ft. in length and is followed by one nearly 400 ft. long. All three conveyors are equipped with Dodge or Robins idlers and all are 24-in. in size. The final belt inclines downward to empty the material on a 2-in. bar grizzly directly above an 8-in. Telsmith gyratory crusher.

Okauchee plant, showing reclaiming tunnel and conveyors

The drag scraper working near the plant supplies the fine material for the operation. It is digging at a somewhat lower level than the average floor of the pit, and hence the conveyor which takes the material up to the plant rises at a sharp inclination. The unusual thing about this scraper is that at present it is hooked up so that it is digging around a corner of the bank from the operator. He can only see the bucket for the interval when it is directly over the conveyor hopper for dumping. Lack of space made this arrangement necessary since about the only good place to locate the scraper hoist was beside the conveyor belt, and this spot was hidden from the rest of the pit by the projecting bank. However, this "blind" operation of the scraper goes on very efficiently without any trouble in getting the sand out.

Like the conveyor from the shovel, the belt from the scraper dumps to a 2-in. bar grizzly above the Telsmith crusher. The throughs from both grizzlies and the crusher discharge all pass by gravity to a revolving scalping screen. The rejects of this screen fall to a Telsmith reduction crusher while the throughs go to the conveyor which takes them up to the washing plant. The discharge of the reduction crusher also falls to this conveyor.

Conveyor Passes Under Highway

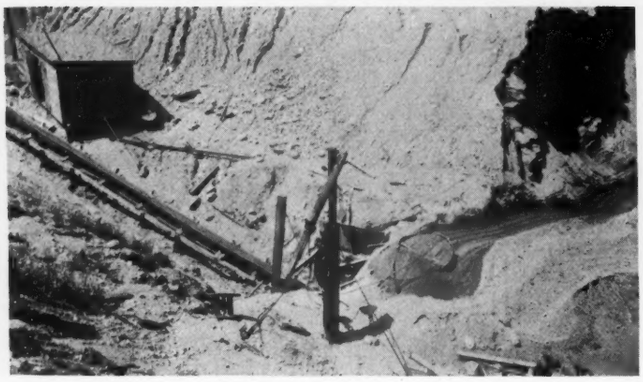
The conveyor from the crushers up to the top of the plant passes directly under the concrete Milwaukee-Madison highway since the pit is on one side of the road and the plant is on the other. This conveyor has Dodge idlers equipped with Timken roller bearings, and is totally in a wooden encasement for its full length to keep the belt from the weather. A 50-hp. Westinghouse motor drives this belt through a Texrope drive and also drives the pair of Telsmith sizing screens to which the conveyor empties. Each screen is fitted with a scrubber section and they are both jacketed. The sized material falls directly to the bins beneath except for the sand which is divided between a pair of Telsmith sand tanks for dewatering.

A power plant beside the washer with a Buckeye semi-Diesel engine is used to generate all of the electricity at the Hartland plant. In addition to this power is furnished by the Milwaukee Electric Railway and Light Co. The same building also houses a well-equipped machine shop for the plant. There is also a well-kept office building beside the hard road.

This plant ships mostly by rail over the Chicago, Milwaukee, St. Paul and Pacific railroad. A siding has been constructed for the plant and a drum hoist car puller has been installed. The company also owns one Titan truck for local deliveries but does not carry on an extensive local

Scraper hopper and pit conveyor

Loading to the pit hopper



Operator in shed does not see scraper bucket except when dumping

Conveyor passes through gateway to reach the main pit

Conveyor from shovel at upper left and conveyor from scraper below

Covered conveyor from pit to screening plant at right, and office at left

Plant of Washed Sand and Gravel Co., Hartland, Wis.

service. The daily capacity at this plant is 1500 to 1800 cu. yd.

Wisconsin Sand and Gravel Co.

The plant of the Wisconsin Sand and Gravel Co., at North Lake, was described two years ago in an editorial letter in Rock Products, but numerous changes in plant layout have been made since that time. The old arrangement made use of pit locomotives and dump cars, a method which was satisfactory while the grades down to where the shovel was working could be kept reasonably small. However, the nature of the deposit permits a deep pit and it was found uneconomical to continue the locomotive operation after the pit reached a depth of approximately 125 ft. The company therefore abandoned the old system and installed a pit conveyor in 1929. This installation has permitted a more flexible operation, and particularly it has allowed the company to deepen the pit, so that now the face is about 155 ft. high. At that depth, the pit floor is below water level, so that pumping is necessary and it is inadvisable to go down any deeper. Incidentally, it is interesting to note that with the old layout the operation of the plant required 12 to 15 men while with the present arrangement only eight or nine are needed.

In the former arrangement, the cars dumped directly to a 12-in. Allis-Chalmers primary crusher. This was necessary as there are a considerable number of large boulders in this bank. However, when the 50-B Bucyrus shovel loads to the pit hopper at present, the larger stones are removed by a 7-in. grizzly above the hopper and hence the need for a large size primary crusher is not felt. The expense of maintaining the 12-in. crusher and operating it with a 150-hp. motor far outweighed its usefulness in this particular

case and the crusher was abandoned. Instead the 24-in belt from the pit runs up to the plant and empties to the old conveyor which formerly took the crusher discharge. This conveyor then takes the material up to a 72-in. by 12-ft. scalping screen in a building midway between the main washing plant and the old location of the abandoned crusher. The rejects of this screen fall by gravity to No. 7 Allis-Chalmers Newhouse crushers and the discharge of these is returned by belts to the scalping screen. These crushers have been in operation for two years and according to the plant superintendent have an extraordinary record for constant service, being only out of service for one-half day for repairs or replacement during the whole period.

The throughs from the scalping screen drop to a 30-in. conveyor belt and are taken up to the main part of the washing plant which is over the storage bins. The belt discharge is divided between a regular 60-in. Galland-Henning cylindrical screen and a set of three conical screens. These latter are in an unusual arrangement since the two smaller screens are inside the biggest one and the middle screen is reversed in relation to the other two. Thus the flow of material is reversed twice as it passes through the series and good washing results are claimed for the layout. The sized material passes by gravity to the bins below, the sand going first to a pair of dewatering tanks.

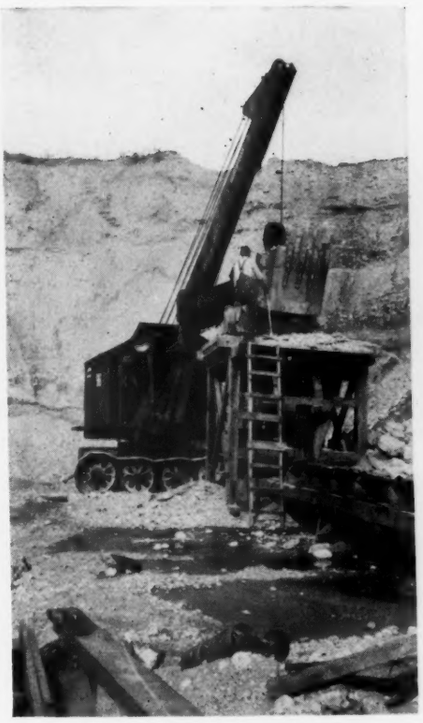
Water for washing is supplied from the pit by a centrifugal pump delivering 800 to 900 gal. per min. This is operated by a 50-hp. Westinghouse motor.

Stockpiling is done beside the plant by means of an American locomotive crane with a 1½-yd. bucket. A long siding permits adequate facilities for stockpiling and also provides good shipping facilities. The plant is located on the line of the Chicago and Northwestern railroad. Shipping is done almost entirely by rail at this plant.

Mayville White Lime Works

The last quarry visited on the trip was that of the Mayville White Lime Works, a short distance to the south of the city of Mayville. This plant is essentially a lime producing operation, and a large scale operation in the quarry is not necessary. On the other hand, the stone must be carefully selected, so hand loading of the quarry cars is used exclusively. The quarry is an old one, dating back to the days when horses and mules were used in getting out the cars of stone. Now a complete electric system covers the quarry.

There are actually two quarries at this operation, the lower



Loading to pit hopper at plant of Wisconsin Sand and Gravel Co.

and older one being practically unused at the present time. Both quarries are in a limestone outcropping which rises to a considerable height above the site of the plant, so that the loaded cars move down grade all the way to the plant. Even so, the hill is so steep right at the plant that a short trestle carries the cars over the top of the plant where they can dump directly to the kilns.

The electric system in the quarry is an overhead trolley above a standard-gage track. The tracks are branched out into finger tracks to reach all points along the face of the quarry, and for the most part the overhead trolley extends to the ends of these branch tracks. However, beside the electric locomotive, there is a Whitcomb gasoline locomotive which is used to reach parts of the quarry where the trolley does not extend. The quarry face is about 35 ft. in height. The usual blasting practice is followed with well drills used for sinking the blast holes.

When the cars are brought down from the quarry they may be sent to either of the three kilns or to the crusher if a crushed product is desired. Three trestles which join together as they reach the solid ground behind the plant serve the three kilns. The trestle to the south, which leads to the old square stone kiln, passes directly beside the main crusher so that cars use it for either this kiln or for the crusher. The other two kilns are of the more modern cylindrical steel shaft type.

The material for the crusher is dumped to an apron feeder to be fed directly to the crusher, and the discharge falls to a large pan conveyor. This conveyor raises the material to the top of the plant and delivers it to a large jacketed sizing screen. The sized material falls directly to the bins beneath, one bin receiving the very fine material from the jacket. The second bin has a gate beneath with a continuous belt feeder attached which permits delivering the material from the bin to a No. 2 Allis-Chalmers pulverator. Likewise, the third bin is fitted with a belt feeder which sends material to another Allis-Chalmers pulverator. The larger sizes can be delivered to a pulverizer manufactured by the Contracting Machinery Co. of Pittsburgh, Penn. The discharges of all three of these pulverizers fall to a single conveyor belt which empties to the boot of a pan conveyor. This conveyor returns the material to the bin for pulverized rock. This rock is used mostly for agricultural limestone, of which the Mayville plant is a great producer.

An interesting sidelight at the Mayville plant is the maintenance of a regular farm on the company's property. Probably this is an outgrowth of the time when a considerable number of horses were needed in the operation and hence some source of feed was necessary. At present the company uses all its spare land for farming purposes, thus cutting down the overhead and diversifying its source of income. A large and well-kept barn is adjacent to the plant and live stock are included in the farming program. In fact, the company maintains quite a sizable flock of sheep which are allowed to roam over the quarry property. They serve the double purpose of supplying mutton and keeping the weeds short.

Crusher house of Wisconsin Sand and Gravel Co., with pit conveyor in foreground and belt to washing plant above

Tractor City Sand and Gravel Co.

Leaving the Milwaukee producing district behind, the next stop was at Janesville, nearly half way across the state from the shores of Lake Michigan.

Pit at Tractor City plant, showing two settling ponds at left and long conveyor at right

This city of about 25,000 is the center of a large producing area for sand and gravel. It is in the edge of the area covered by glacial moraines and there is an abundance of clean and well graded gravel here. Although Janesville is a prosperous and growing community, it cannot absorb any large percentage of the gravel produced in the area, so that much of the material produced here is shipped for considerable distances.

Several plants are in or near this city. The Janesville plant of the Tractor City Sand and Gravel Co. is typical. This plant is about ten years old but has been constantly enlarged and improved so that today it is a steady and exceptionally efficient producer.

The pit at this plant is rather large in size and has a face of 95 or 100 feet. The deposit runs about half and half gravel and sand, and is only loosely compacted so that there is no difficulty in getting the material out. In fact, the deposit is so easy to work that a crane is employed in the pit in place of the usual shovel, and its operation has been entirely successful. The crane used is a Link-Belt electric one with 1-yd. bucket. The material is loaded to a pit hopper from which it is fed to the first of a series of three conveyor belts, the final one of which delivers the material to the scalping screen. The combined length of the three belts is approximately 750 ft.

The scalping screen is in the open at one end of the washing plant. It is equipped with manganese steel wire mesh to provide greater screening area and longer lasting quality. The plant superintendent, Henry Schloemer, said that he found the screen lasting three times as long as ordinary screening, and at the same time the screening was more efficient because there were no dead spaces between the openings.

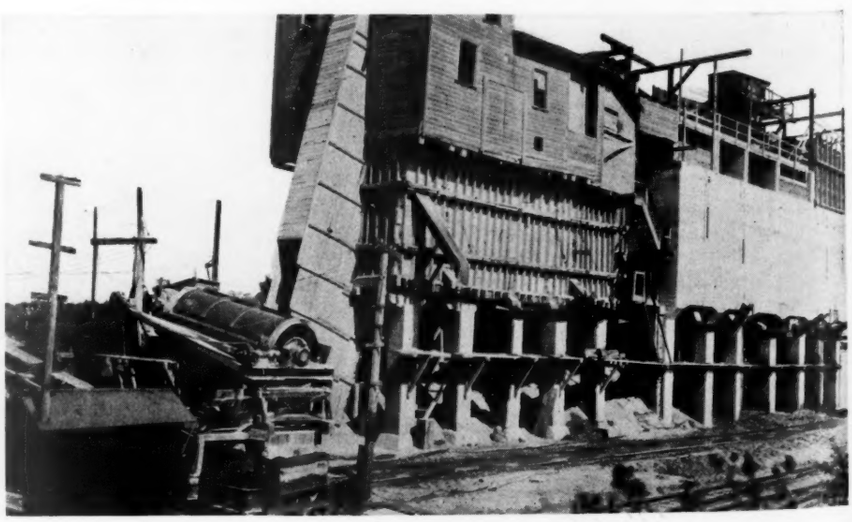
The rejects of the scalping screen are returned to the crusher house beside the plant, where they fall to a bar grizzly which sends the larger size boulders to a Cedar Rapids jaw crusher and divides the smaller stone between a pair of McCully gyratory crushers. However, since there are few large stones in the deposit and the gyratory crushers are not overcrowded, it has been found advantageous to bypass the large jaw crusher and send all the material to the pair of smaller crushers. Moreover, because the material to be crushed is not great and the pair of crushers can handle it easily, it is not necessary to have a man watching at this point, as is usually the case with gyratory crushers. This is only one of the many points around this plant where careful operation has eliminated the necessity for manpower. The discharge from the crushers falls to the main pit conveyor belt and is thus taken directly back to the scalping screen.

The material passing through the scalping screen is carried to the top of the plant by a bucket elevator, where it can be delivered either to the "wet" or the "dry" plant. Since there is practically no demand for unwashed, dry, sized material, the dry plant is not now being operated. It could, however, be operated as a wet plant, since it is equipped for washing, if the demand on the company should require it. However, at present the regular washing unit can produce all the material needed, so all the elevator discharge is delivered to this unit.

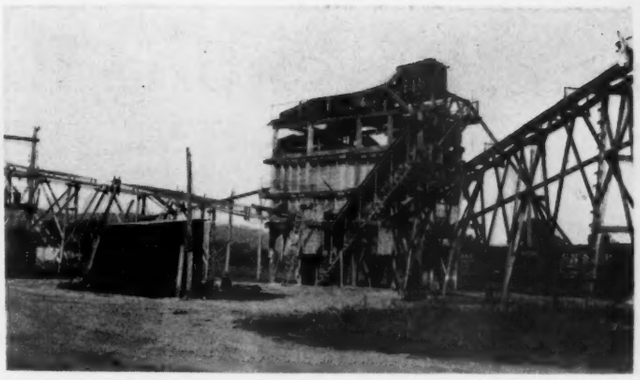
At the top of the plant the material for the washing unit is delivered to a double-deck Link-Belt vibrator which operates under a constant spray of water. The spray comes from five pipes placed across the vibrator just above the upper deck, these pipes being pierced at regular intervals for the water streams. The washing accomplished is of a very good character because of the large number of jets of water directed directly on the gravel under a considerable pressure. The rejects of the upper deck of the vibrator fall at once to the bin below, while the rejects of the lower deck, which are of pea gravel size, drop to a Link-Belt sand drag below and to one side of the vibrator. The throughs, or torpedo sand material, fall to another sand drag beside the one just mentioned, and this is also of Link-Belt manufacture. The material from the two drags are delivered to two bins below. The vibrator and the two sand drags are all operated from the same 25-hp. General Electric motor.

The dry sizing unit, which is not at present operated, is equipped with two revolving screens. These screens need more water to accomplish the same amount of washing and also require more power to operate than does the double-deck vibrator, so that their regular operation would, of course, be uneconomical.

Two ponds in the pit supply the water for washing. The system employed is to reuse the wash water, and hence the water used is allowed to flow back to the far pond where the silt and dirt can settle



Double screening plant of Tractor City company. Old dry plant at left and new washing unit at right



Dredge and screening plant of Prairie Sand and Gravel Co., Prairie du Chien, Wis.

out. From there it flows into the lower pond, which is long and narrow in shape, so that additional settling is accomplished there between the time of the entrance of the water at the far end and its removal at the end near the plant. This provides a very clear wash water, free from silt and foreign matter. A 5-in. Allis-Chalmers centrifugal pump delivers 750 gal. per min. to the plant for washing purposes.

The company does some stockpiling beside the railroad track to the north of its plant. A Browning ½-yd. electric shovel is used for this work. At the present time the company is enlarging its trackage facilities so that when the job is finished it will have about twice as much trackage as formerly. The banks beside the railroad are being cut away to the north and south of the plant and a second track beside the present siding is to be installed. The present track will hold about 20 empties waiting for loading and 20 full cars to go out.

One of the most interesting points about the whole plant is the efficiency with which it is operated. The plant is capable of turning out about 40 cars in a 10-hr. day, and although the operation is not now for the full 10 hrs., the plant still has a good daily production. Yet only three men and the superintendent are required for its operation. There are two men in the pit—the crane operator and a man to watch the pit hopper and tend the belts. Then at the plant there is only one man for loading. The rest of the plant "runs itself," except that Mr. Schloemer, the superintendent, is all over the plant constantly watching the operation. To add to the facility of operation there is a well-equipped shop for repairs and new equipment which is fitted with a good lathe and a forge.

O. G. Olsen of Janesville is president of the Tractor City company. At present his company is shipping only by rail, but when the new roadway and stockpiling facilities are completed the company expects to enter into the trucking business. Some of the material now shipped goes a distance of about 130 miles, but most of it is used at points nearer the plant.

Prairie Sand and Gravel Co.

Across the lower edge of Wisconsin west of Janesville there are few rock products plants. Such gravel plants as there are, are small in size and purely local in character. This is true because the territory is outside the area of the moraines and deposits are generally of a poorer nature. Also the demand in the area is not so great, as the number of medium-sized, prosperous towns is few compared to the towns in southeastern Wisconsin. However, there are a few plants along the Mississippi river, and the Prairie Sand and Gravel Co. is one of the largest in the territory and typical of all the plants. This plant is located at Prairie du Chien, a community of about 4000.

The plant is located on the Mississippi river only a short distance from the water's edge, so that the gravel found in the pit is entirely a river deposit. This means that it is very uniform as to size, with only a very few large stones. Because of the grading of the material and also because the surface of the ground is only a few feet above water level, it is obvious that a dredging operation would be the logical installation. Such a layout has been installed and is operating efficiently.

There is no stripping necessary, the only preparation being the dragging of the area about the pit to remove the heavy growth of weeds to be found on this low land. The dragging is done with a farm harrow drawn by a tractor.

The dredging unit is installed on a square barge and is totally enclosed. It consists of an 8-in. American Manganese Steel Co. centrifugal pump driven by a 150-hp. motor. The pipe line to the plant is carried to the shore over a train of pontoons made with common steel drums.

The discharge from the pump is delivered to a square wooden box at the top of the plant which breaks the force of the pipe discharge and allows the material to flow to the sizing screen instead of being forced into it under pressure. This permits the material to contact the whole screen instead of only the lower half, as might be the case if the discharge were shot into the screen directly. Also, this box acts as a settling basin where the largest stone drop to the bottom and do not go to the screen at all. The box is about 8 ft. long and 6 ft. across.

The sizing screen is a jacketed Telsmith "Ajax" screen with a scrubber section. When the plant was visited, two sections of "Rolman" manganese steel screens were being used on this screen and were reported satisfactory. The jacket produces sand, ¼-in. material and ½-in. material. From the screen proper comes material up to 1½-in., and everything above that goes to a special bin or else is crushed. Since the largest stones encountered are only 4 to 5 in. in size, a large crusher is not necessary. A Universal No. 2M jaw crusher takes the rejects, and the discharge of this crusher drops directly to the 1½-in bin beneath. The sand goes to a pair of Telsmith sand boxes for dewatering.

The Prairie company does little stockpiling, but is equipped to place piles at either end of the plant if desired. An inclined conveyor from beneath the bins has been installed at either end of the plant, and these conveyors will pile all the material the plant needs stored. Ordinarily the plant loads directly to cars, there being two tracks for the loading. One track passes directly under the plant while the other is immediately beside it to the north. On the south side of the bins are the batch boxes for loading to the trucks. The plant does some local hauling, but most of the material is shipped out by rail.

The company owns an International and a Ford truck for its local hauling. It also has two Fordson tractors for general utility work around the plant. One of these is fitted with a Hersted hoist and is used for pulling cars.

This plant is capable of turning out as much as 20 cars a day, or 60 cu. yd. an hour. The plant is a comparatively new one, being only a little over two years old. It is on the property occupied by a former plant, but the pit now being operated is somewhat removed from the old location. C. J. Knight, of Prairie du Chien, is president of the company.

Preventing Bridging in Sand Feed Hopper

TEN CONTRIBUTORS, from Germany to Australia, have offered suggestions or solutions to the problem presented to ROCK PRODUCTS, September 27, 1930, p. 69. Incidentally, each received his reward of $5 as promised.

The problem was in connection with feeding a sand and gravel plant from an open hopper. The material comes from a bank deposit that runs 97% sand and 3% gravel from ¼ to 5 in. This is brought up by a drag scraper bucket which dumps into the open hopper.

The material drops into the open hopper on a flanged drum feeder, which feeds a steady flow to the belt conveyor below. This feeder works splendidly for the purpose of regulating the flow to the belt, but it does not prevent the material from bridging in the hopper, so it is necessary to have a man at the hopper with a rod or poker to keep the material moving in the hopper.

The accompanying illustration shows a cross-section of the hopper and a suggestion of a traveling chain. The editors also suggested changing the slope of the sides of the hopper, somewhat as shown in the dotted lines.

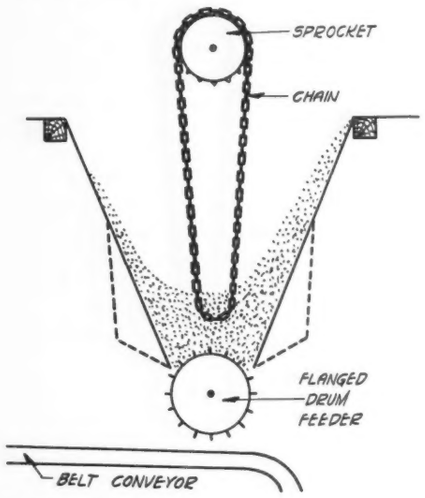


Fig. 1. Cross-section of the hopper with suggested rotating chain

A California reader, who does not wish his name mentioned, suggests that at one plant the bridging of fine material was prevented by the use of an electric vibrator which had been salvaged from an electric vibrating screen. A simpler mechanical device had been tried, but it was found that a light rapid tap was better than a slow and harder blow.

Any Problems to Be Solved?

LAST FALL a subscriber asked our help in solving an operating problem. We constantly answer a lot of these questions by correspondence direct, and with little hesitation. But in this case we offered our suggestions publicly, with some misgivings, and they seem to have been partly right, and partly "all wet"; and at the same time we asked for volunteers to give their suggestions.

Here they are, ten good operating men and true, from all over the United States and from Germany and from Australia. We thank them one and all.

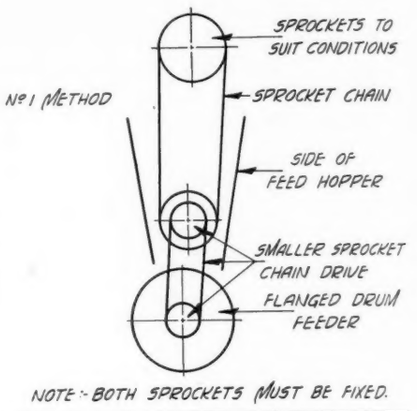
Has anybody else got any other problems to solve? If you have, send 'em on. With 5000 experts scattered over the world we ought to find a solution!—The Editor.

The same operator suggests installing two sheet-steel discs about 4 ft. in diameter on a heavy shaft running through the hopper so that the discs would be about 1 ft. apart, parallel with the feeder and with the bottom of the discs close to the feeder. Short pins would be attached at periphery of discs, projecting one or two inches each side. By means of worm gears or other speed reducers the r.p.m. could be cut down to one revolution per two minutes, thus reducing the power requirements. If the arching did not extend very high in the bin, he suggests that thin arms might be attached to the shaft instead of the discs.

A. M. Parker, 4301 River Road, Washington, D. C., believes from his experience that if a chain is used as previously outlined, the links will pile on top of the sand and gravel after being rotated with the sprocket. He bases this on actual trials with sand and gravel and also in a bin of portland cement where the scheme was a failure. As an alternative, he suggests the ideas that are incorporated in methods Nos. 1 and 2, as shown in Fig. 2. His first suggestion is to have a shaft running across the throat of the hopper to which are keyed two small sprockets. Suitable chains connect these sprockets with the one above and with one below from the flanged drum feeder.

His second method or suggestion is basically the same as that suggested by the California operator except that he advises using a paddle made in the form of a "U" with the drive shaft bisecting the paddle, as shown in the lower half of Fig. 2, instead of using discs.

C. B. Conover, Peru Road, Clifton, N. J., states: "I have had considerable experience in the designing of bins to handle



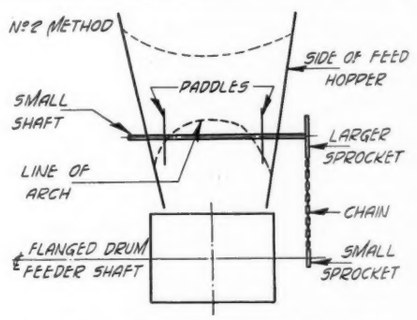


Fig. 2. Two methods suggested by a Washington man

all kinds of material and my experience has been, that if a bin is constructed as shown in the accompanying sketch (Fig. 3), with two straight sides, the material will flow out with no bridging or arching."

J. Alex. Woodward, 125 Virginia Avenue, South, Clarendon, Va., offers practically the same solution, which is shown in Fig. 4, and further suggests that the valleys in the bin be kept at a 12 to 12 slope. (Fig. 4.)

Dan Paris, Monrovia, Calif., contributed his ideas, which are incorporated in Fig. 5. He says in his communication: "A few years ago I experienced the same trouble. We had a sand that contained a lot of silt and was pretty wet and mean to work with. This is what we did, and it did the work O K: We pulled the

sides and ends of the hopper in to about 65 deg., and this gave us a hopper 6 ft. square at the top and 2 ft. square at the bottom. We then installed a drum 24 in. in dia. and 28 in. across, with a 6-in. opening on discharge side, with a piece of rubber belting over the opening to help adjust feed. Note in the accompanying drawing the way the drum is installed

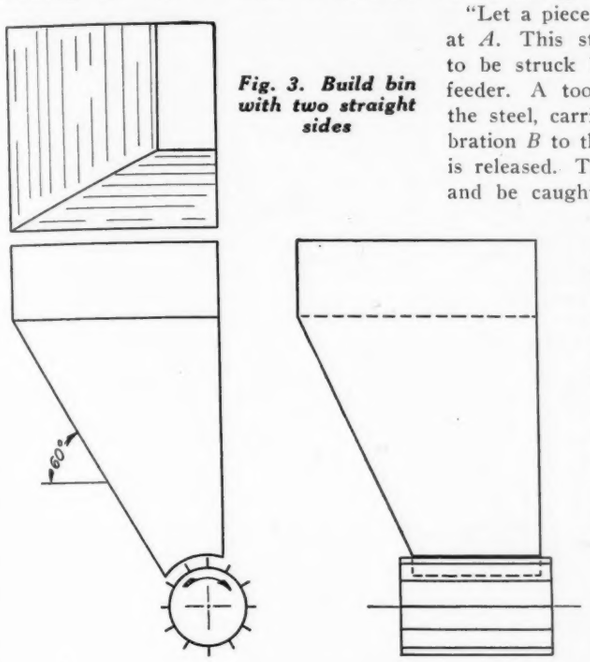


Fig. 3. Build bin with two straight sides

in hopper, one-half of it being inside. The idea of this was to get as much of the material lying on the drum as possible, which makes it an agitator as well as a feeder. The drawing shows front and back of hopper. The sides come down to the top of drum and extend 2 in. over edges. Flanges on the drum are set 3 in. from edges of drum to give clearance from sides."

T. P. Wootton, of Socorro, N. M., believes that the rotating chain idea is a good one if a sprocket is placed at the bottom, but he says that the installation and running expense might be an objection. His other suggestion is quite novel, and referring to Fig. 6 he says:

"Let a piece of spring steel be secured at *A*. This steel must be long enough to be struck by the teeth of the drum feeder. A tooth comes in contact with the steel, carries it along its path of vibration *B* to the point *D*, where the steel is released. The steel will then fly back and be caught by the next tooth. The amount of vibration will depend to a large extent upon the diameter of the drum and the length of the teeth. It is my opinion that a very small amount of vibration will prevent the arching. It may be that the sand will tend to pack behind the steel and prevent its return to normal position. A heavy spring arrangement somewhat as indicated at *E* would no doubt correct such a tendency. This scheme would have a low installation cost and a practically negligible operation cost."

Arthur C. Hewitt, engineer for the American Lime and Stone Co., Bellefonte, Penn., submits three plans which are illustrated by Fig. 7. His communication states:

"Plan No. 1 is to place a smooth plate in a vertical position held rigidly directly above the bottom opening. This idea is somewhat of a makeshift and is not recommended as a permanent solution.

"Plan No. 2 requires changing of the bin bottom so that one side of it is vertical. The idea back of Plans 1 and 2 is to obtain a smooth vertical face against which it is difficult for material to hang. Without one smooth vertical side there is a more decided tendency for material in the bin to jam against itself and the sloping sides. Experience shows that with one vertical side or a smooth plate in the center of a hopper material will always flow faster against the vertical plate than it will on the other sides, and there is less tendency to jam.

"Plan No. 3 shows an arrangement which is superior to either 1 or 2 and if possible to reconstruct the bin bottom

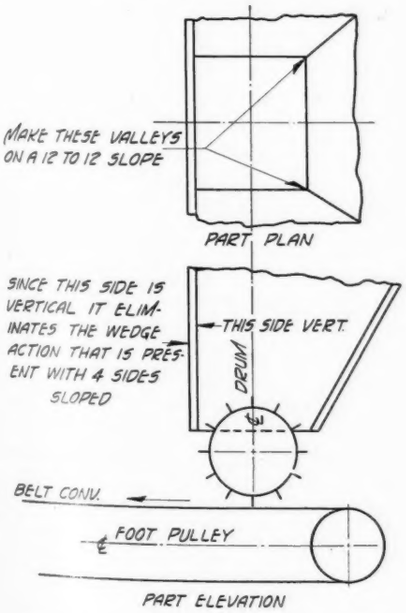

MAKE THESE VALLEYS ON A 12 TO 12 SLOPE
PART PLAN
SINCE THIS SIDE IS VERTICAL IT ELIMINATES THE WEDGE ACTION THAT IS PRESENT WITH 4 SIDES SLOPED
THIS SIDE VERT.
DRUM
BELT CONV.
FOOT PULLEY
PART ELEVATION

Fig. 4. One vertical side suggested

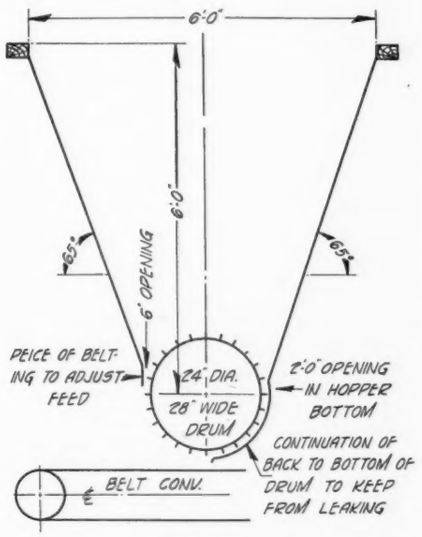


Fig. 5. This placing of the drum makes it an agitator

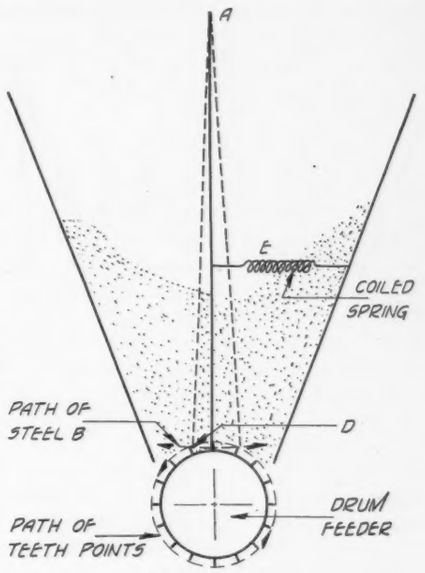


Fig. 6. This method has merit of low cost

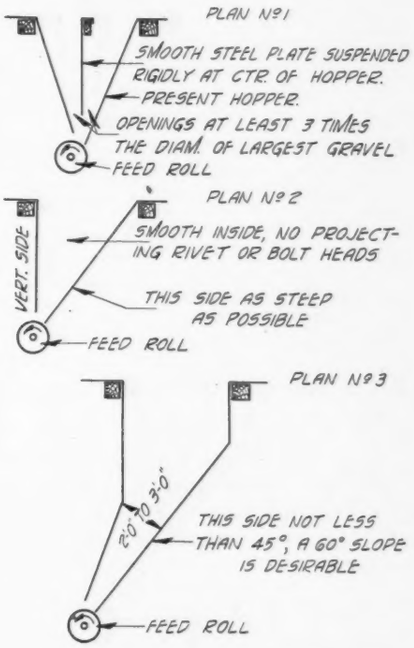

PLAN Nº1
SMOOTH STEEL PLATE SUSPENDED RIGIDLY AT CTR. OF HOPPER.
PRESENT HOPPER.
OPENINGS AT LEAST 3 TIMES THE DIAM. OF LARGEST GRAVEL
FEED ROLL
PLAN Nº2
VERT. SIDE
SMOOTH INSIDE, NO PROJECTING RIVET OR BOLT HEADS
THIS SIDE AS STEEP AS POSSIBLE
FEED ROLL
PLAN Nº3
2'-0"
3'-0"
THIS SIDE NOT LESS THAN 45°, A 60° SLOPE IS DESIRABLE
FEED ROLL

Fig. 7. Three suggestions of a Pennsylvania producer

tc get a condition such as Plan No. 3, ıere will be no jamming take place unless the material itself is so sticky due to clay, etc., that it will hang up vertically when allowed to stand for any length of time in a bin."

Ed. Webster, chief engineer of the Ross Screen and Feeder Co., 247 Park Avenue, New York City, believes that the original chain idea was all right, but that the weight of the chain suitable for operating over a sprocket would not be sufficient to secure agitation of the sand. He further states that his company has developed a chain control, which with the drum it has patented, enables the use of a chain that is heavy enough for any duty involved, and that he has secured satisfactory results under similar conditions.

A suggestion from the other side of the globe by **J. J. Grierson,** consulting engineer of the Noarlunga Sand Co., Ltd., 62 Waratah St., Seacliffe, Adelaide, South Australia, is the ninth suggested solution, the details of which are shown in Fig. 8.

Mr. Grierson states he has used this satisfactorily on hoppers up to 500 tons capacity on fine material, coarse stone and irregular sized material, and with good results in every case.

The device consists of a flat plate inside the hopper above the discharge door and so arranged as to form an annulus between the sides of the hopper and the edge of the plate. He usually supports the plate by means of two angle iron bars run across underneath the plate and at-

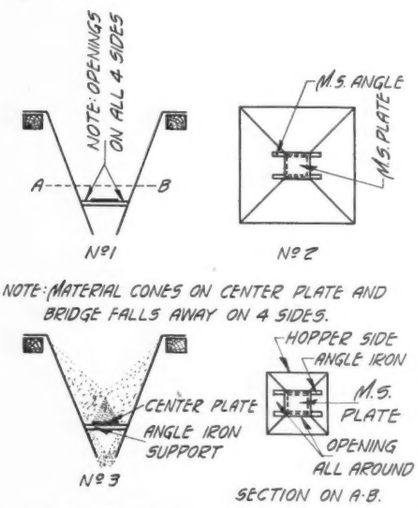


Fig. 8. This idea comes from Australia

tached to the sides of the hopper; this is shown in sketch Nos. 1 and 2 of Fig. 8.

The central plate supports a cone of the material in the center of the hopper and the material cannot bridge but slides down past the sides to the discharge opening. This is shown in No. 3, Fig. 8.

From Germany, **Wilhelm H. Dopp,** Münster, Westphalia, sends the suggestions illustrated in Fig. 9. He writes: "The chain suggested must dangle down-

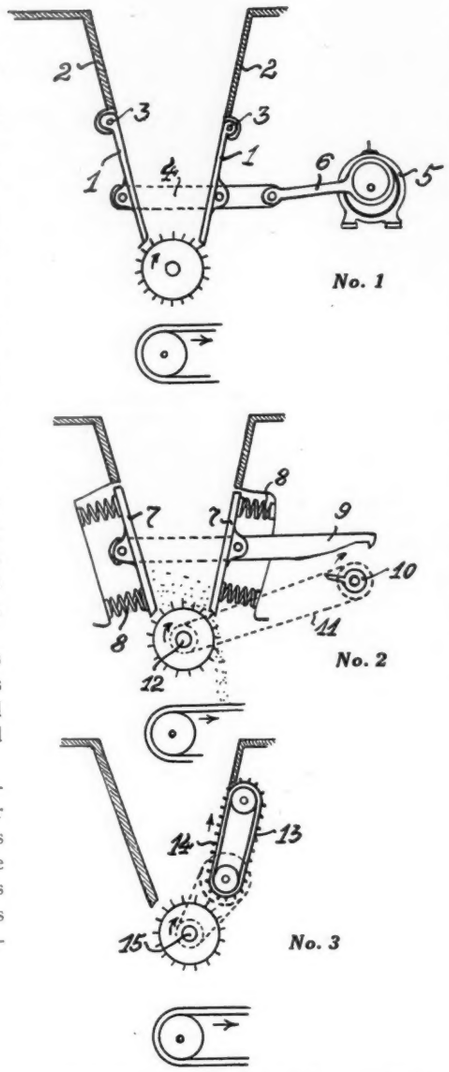


Fig. 9. A German reader prefers movable parts in the side of the hopper

wards near to the drum feeder if it is really to prevent bridging. Now, its length may increase by wear in the course of time, or it may fall from the sprocket; then the chain certainly will injure the drum feeder.

"If, in the neighborhood of the hopper, there is a pipe delivering compressed air, it would be possible to blow air into the interior of the hopper, producing a mixture of air and sand that flows like a liquid and does not bridge.

"But I think it best to prevent bridging by providing movable parts in the sides of the hopper in order to continuously shake the places which might form the abutments of the arch.

"These movable parts can be oscillated, preferably by vibrations of high frequence, or they can be formed of conveyor belts which are preferably provided with scrapers. In each case, the movable part of the hopper must extend so far upwards that the distance between the fixed parts above is too great to allow any bridging of the sand.

"A drawing which illustrates my suggestions is shown in Fig. 9, the interior parts (1) of the walls of the hopper (2) are pivoted at (3) and connected by a rod (4). This rod is oscillated rapidly by an electric motor (5) by means of an eccentric gearing (6).

"Sketch 2 (Fig. 9) shows another embodiment of my suggestion, in which the movable parts (7) of the hopper are secured to strong springs (8) fixed on the foundation. The frequency of the vibration depends on the dimensions of these springs; the driving motion need not be rapid, but should be sufficient to knock the bar (9) occasionally by means of the cam (10), which may be rotated by the chain (11) agitated by drum shaft (12).

"If the hopper is not strong enough to stand the vibrations, in the proposal represented in Sketch 3 (Fig. 9), a belt conveyor (13) is supplied with scrapers (14) on one side of the hopper for withdrawing the foothold to the arch. This conveyor may be rotated also by the drum shaft (15), as it need run but slowly. In this way the power necessary for agitating the movable parts will be much diminished; this power can be furnished from the drum feeder shaft without reinforcing the driving energy."

Power Rate Rehearing Asked by Consolidated Cement Corp.

THE CONSOLIDATED CEMENT CORP., Mildred, Kan., has asked a rehearing before the state public service commission of the complaint of the Kansas Utilities Co. which resulted in increased power rates for the cement company.

The Mildred case has been before the commission in one form or another for several years back. It is one of those "precedent" cases. The legal controversy started when the cement company, some five years ago, contracted with the Kansas Gas and Electric Co. for electricity.

The Kansas Utilities Co. of Fort Scott came in and protested, on the ground it was entitled to the business; that the commission could no allow another company to come into its territory. It offered to sell power at the same contract price offered by the Kansas Gas and Electric Co. The home boys won out—and have been buying electricity from the K. G. & E. and selling it at the K. G. & E. price ever since.

After an interval the Kansas Utilities Co. came before the commission and asked for a higher rate from the cement company, on the ground it was doing business at a loss. The commission granted the increased rate in an order issued last month. Now the gas company wants a rehearing, and evidently intends to take the case to the courts if it does not get it, or if it loses on a rehearing. —*Topeka* (Kan.) *Capital.*

Mining, Crushing and Grinding Methods and Costs, Reliance Quarry, Giant Portland Cement Co.*

By S. G. McAnally†

THIS IS ONE of a series of papers describing mining and crushing methods and costs at cement plant quarries throughout the United States and deals directly with the methods employed and costs obtained at the Reliance quarry of the Giant Portland Cement Co. at Egypt, Penn., although it is more or less descriptive of the methods used throughout the Lehigh Valley cement district. Systems of transportation vary according to local conditions, such as proximity to the mill, depth of quarry floor with relation to the mill level, etc. Methods of prospecting differ mainly in the type of drills used. Systems of storage, crushing and grinding vary chiefly in the types of units.

Most of the information regarding the early history of the Lehigh cement district was obtained from the "History of the Portland Cement Industry of the United States" by Robert W. Lesley, the first president of the Portland Cement Association. The writer is indebted also to Charles Clader, Giant Portland Cement Co. quarry superintendent, for valuable information regarding present and past methods and equipment.

Some information on the geology of the district has been gleaned from Prof. Benjamin L. Miller's report on the limestones of Pennsylvania. Other statements regarding the geology are based on personal observation and on the interpretation of the analyses of samples of rock from numerous test holes drilled over a large area.

History

The Lehigh Valley cement district was discovered and brought into being through the need of cement mortar in the construction of artificial waterways before the advent of the railroads.

About 1830 a small cement plant was built on the Lehigh canal at Seigfried's Bridge, under the ownership of Gen. J. K. Seigfried, one of the pioneers of the industry. The natural cement manufactured was used largely in the construction of the Lehigh Coal and Navigation Co.'s canal from the coal regions to Easton, Penn. Other cement plants followed and the success of the natural-cement works in the Lehigh district led to the establishment, in the 80's, of a plant at Egypt, Penn.

*Reprinted from U. S. Bureau of Mines Information Circular 6448.

†One of the consulting engineers, U. S. Bureau of Mines, and chief chemist, Giant Portland Cement Co.

Synopsis

THIS ARTICLE covers much more than appears in its title. Of interest to all quarry men and particular interest to cement plant chemists is the description of methods used for prospecting and sampling the rock deposit.

Well drills are used for this, and samples are taken every 5 ft. of hole. By ingenious manipulation of these samples, even with a rock that varies quite considerably in composition, the initial blending of the raw materials is accomplished in the quarry, and subsequent control is made simpler.

Apparently here is a cement company quarry where the chemist starts his control in the unblasted ledges—something entirely logical but not so often practiced. —The Editor.

The Giant Portland Cement Co., originally the American Cement Co., was organized in 1883. In 1898 the company was operating four plants in the vicinity of Egypt. The kilns used were the upright, intermittent type, but in the latter year rotary kilns 60 ft. long were installed at one of the above plants. In 1900 the Central mill was built and was equipped with rotary kilns only. The Reliance mill was built in 1905 and the present quarry was opened in the same year.

Geology

The cement rock of the Lehigh district, as found in the Reliance quarry, belongs to the Jacksonburg formation and is a continuation of a belt that extends from Belvidere, N. J., on the Delaware river, through Stockerton, Bath and Northampton, to about 10 miles west of the Lehigh river. The belt is only a few miles wide, yet there are about 25 cement plants located on it.

The strata consist of a basal layer of crystalline limestone mixed with dolomite, and an upper layer of argillaceous limestone (cement rock), which comprises most of the formation. The northern boundary of the cement rock can sometimes be determined by an abrupt change in the topography, the line of contact being at the base of the steep slopes which mark the southern margin of the slate belt (Martinsburg formation), which overlies the Jacksonburg limestone. The southern boundary is sometimes marked by a change in slope to the more soluble underlying high-grade limestone (Beekmantown formation), but the geology is not regular.

In some areas large lenses of high-grade cement rock are embedded in very low-grade material; sometimes the rock is covered by residual clay to a depth of 50 ft. There are several large outcrops of dolomite which are probably overlain with cement rock.

The cement rock is a black slaty stone, intermediate in composition between limestone and slate. The calcium carbonate varies from 55 to 85%. In the developed areas the variation is not so extreme and the rock will average about 75% calcium carbonate. This is the approximate percentage required in the raw mix for the manufacture of portland cement; hence the name "cement rock." The rock is comparatively soft and is laminated due to its slaty nature. Following is the analysis of the average cement rock from the Reliance quarry:

	Per cent.
Silica	14.80
Iron oxide and alumina	7.20
Calcium carbonate	72.50
Magnesium carbonate	4.10
Water, alkalies, etc.	1.40

The above material must be mixed with some high-grade limestone in order to increase the calcium carbonate content to the desired percentage (about 75%). Some cement companies in the Lehigh Valley are more favored than others in having, adjacent to their plants, deposits of limestone which can be quarried and delivered to the mill for the same cost as the cement rock. At some mills the cement rock is sufficiently high in calcium carbonate to require the addition of clay or other argillaceous material in order to regulate the mix. No workable deposit of high-grade calcium limestone has been discovered in the vicinity of Egypt, and the limestone used at the Giant Portland Cement Co.'s plants is purchased and shipped from Annville, Penn. The cost delivered at the mill is $2.40 per long ton, or about seven times as much as the cost of the cement rock. Therefore it is not economical to work low-grade deposits of the latter.

Reliance Quarry

In some places the cement rock outcrops, but as a rule it is covered by a clay overburden which varies in thickness from 1 to 20 ft. Sometimes the clay extends to greater

depth in pockets, chasms, fissures or wide cracks in the otherwise solid rock. Occasional seams of quartz and soapstone are encountered but not in sufficient quantity or thickness to interfere with the method of quarrying.

Good cement rock is found to a depth of at least 230 ft. within the area of the present workings. This area is located in the southeast section of the quarry (see Fig. 1). The strata dips in a northwesterly direction at an angle of about 5 deg. Faults are rare and folding occurs only in a few places. The composition of the rock varies considerably in localized sections, but the method of quarrying reduces this variation so that the rock delivered to the mill will average between 70 and 75% calcium carbonate. A plan of the quarry and the track layout is shown in Fig. 1. A section of the present face showing location of strata is shown in Fig. 2. A longitudinal section of the rock below the floor of the quarry is shown in Fig. 3.

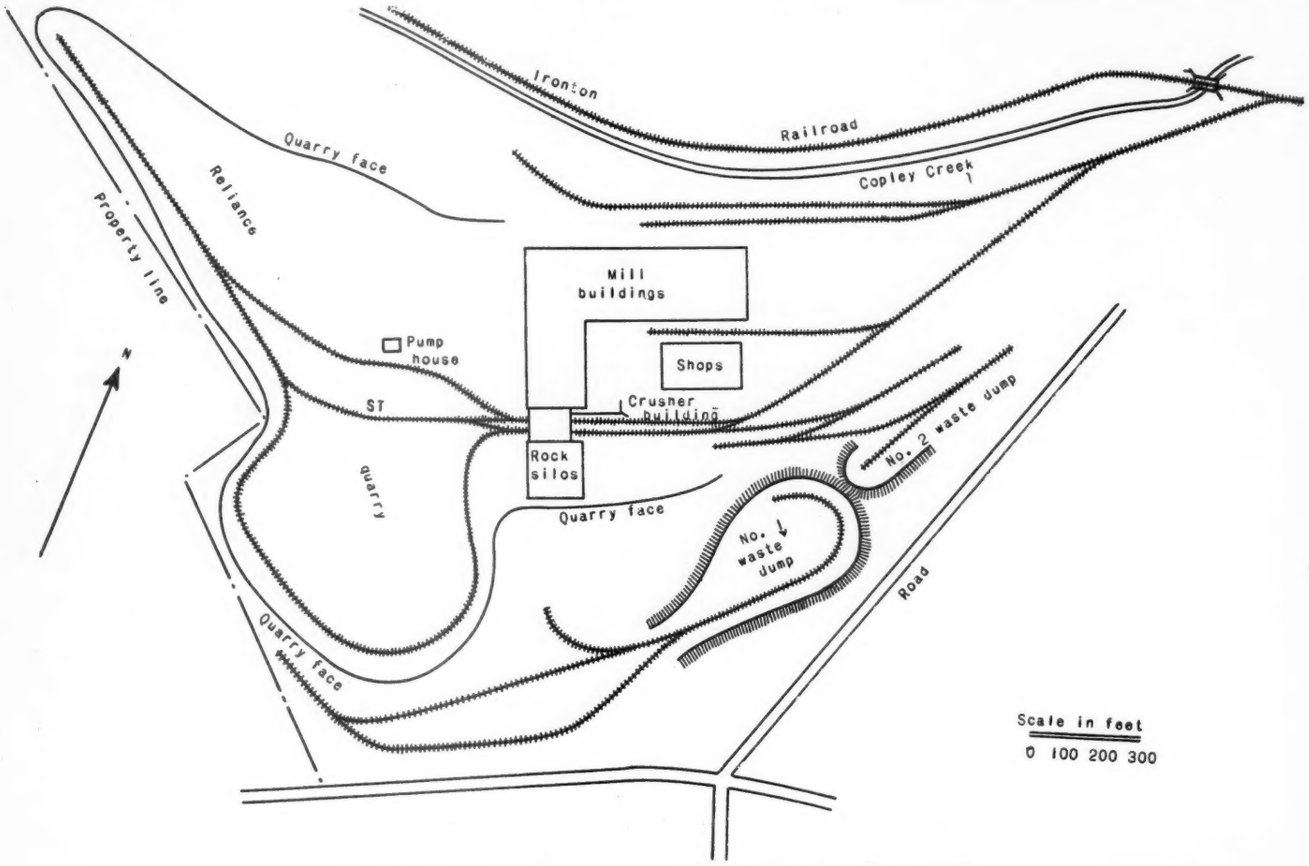


Fig. 1. Plan of Reliance quarry of Giant Portland Cement Co.

Prospecting

Considerable prospecting has been done on the Reliance and adjacent properties of the company. One gas churn drill is used continually for this purpose. Test holes 6 in. in diameter are drilled to a depth of from 100 to 200 ft. In new properties the holes are first drilled on the corners of a 250-ft. square, and if the results of the tests indicate that further prospecting is necessary, the spacing is reduced, either for the purpose of tracing high-grade rock when it is encountered or to eliminate any doubts as to the value of the prospected area. Numerous prospect holes have been drilled from the surface of the Reliance quarry to a depth of 230 ft. The quarry floor has been prospected to a depth of 100 ft. As the present face is moved ahead, additional test holes are sunk in the new floor area on 100-ft. squares, and the results are tabulated and recorded for future reference.

A Loomis No. 4 "Clipper" drill is the type used. The average footage drilled per day of 10 hours is approximately 40 ft. The speed varies with the strata encountered, which consists of clay, cement rock, veins of limestone and quartz, dolomite and slate. The dolomite is the hardest rock encountered in large masses. The rate of drilling becomes slower with increasing depth. When water is encountered in the drill holes the footage drilled in unit time is much less than the average. The average cost of drilling prospect holes is $0.405 per ft. This cost includes labor (two men to a drill), material and fuel, repair labor, and also covers the time used in moving from one location to another.

Methods of Sampling and Analysis

Samples are taken from each 5 ft. of drill hole. Each time the sludge is bailed out the first portion is thrown away and the second fill of the bailer is caught in a water pail; all other bailings are thrown away. The sample in the pail is washed free from clay, is mixed well, and put into a small tin box or a tobacco can, several of which are provided for the purpose. Each can is marked with the number of the test hole and the depth at which the sample was taken.

Samples are dried and pulverized and a determination for carbonate, in terms of calcium carbonate, is made on each one by the simple and rapid acid-alkali method. After all samples from one hole are tested in the above manner a composite is made of all the samples of that hole. A carbonate determination is made on the composite; the result should agree with the arithmetical average of the individual results within 0.2%. The actual lime in the composite, determined by the potassium permanganate method, is calculated to calcium carbonate. The difference (plus or minus value) between the actual calcium carbonate obtained by the acid-alkali method is added to the individual results so as to obtain the correct values. The composite samples are also analyzed for magnesia.

In using the acid-alkali method for the estimation of calcium carbonate in limestone, cement rock and cement mixes, it is customary to standardize the acid and the alkali solutions with a standard sample of material approximating the composition of the samples to be tested. If the standard

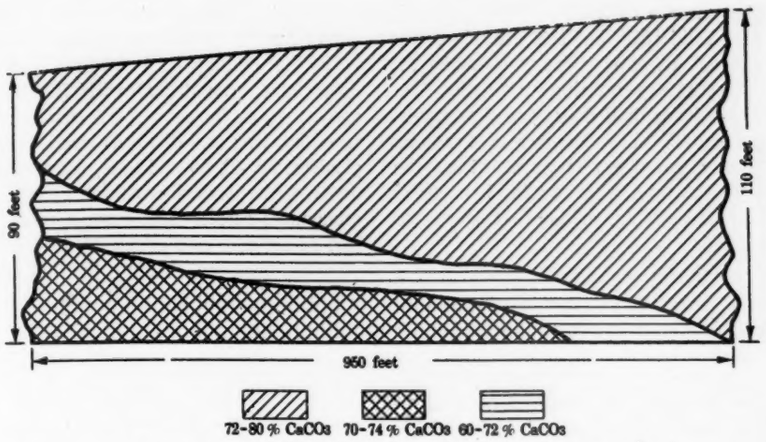


Fig. 2. Section of south face of quarry showing composition of strata

sample contains 42% lime (75% $CaCO_3$) and 2% magnesia, a sample of rock which by this method analyzes, say, 70% calcium carbonate, contains the equivalent of 70% $CaCO_3$ and 2% MgO. But if the actual MgO is more than 2%, then the $CaCO_3$ will be less than 70%, and as the percentage of magnesia may vary in different sections and strata of a property, it is necessary to make a determination of the lime in the composite in order to check and make any correction of the acid-alkali determination.

When the acid-alkali result exceeds the actual calcium carbonate content, the difference, especially if considerable, can be attributed to a higher percentage of magnesia than that in the standard sample. This difference multiplied by 0.4 will equal approximately the increase in the percentage of magnesia. Other acid-soluble basic impurities affect the acid-alkali determination, but to a less degree.

Estimation of Tonnage

Based on the analyses, areas are mapped out so that the average calcium-carbonate content of the whole area will exceed 70%. The available tonnage is estimated on the basis of 155 lb. per cu. ft. Due to the fairly regular and solid formation of the rock, especially below the quarry floor, the tonnage can be estimated closely.

Methods of Quarrying

The open-pit method of quarrying has been used from the beginning of operations in the Reliance quarry. The first cut was made at the mill site in order to excavate for the crusher and adjacent buildings. The area extending from the mill to the northwest was the first developed and worked due, no doubt, to the fact that it had less than 1 ft. of overburden. When the good rock in this section became exhausted, or nearly so, the area to the southwest was prospected and developed. The overburden in this area consists of a yellow clay. The amount of clay per thousand tons of cement rock is approximately 100 cu. yd. This estimate applies only to the southwest area.

This heavy clay overburden is removed by stripping with a power shovel and a dragline scraper supplemented with some pick and shovel work. Due to the clay-filled crevices previously mentioned which, in part, cannot be stripped by the regular methods with economy and safety, some waste is shot down with the rock. The waste removed in the quarry proper by the power shovels and transported to the No. 2 waste dump amounts to approximately 2% of the rock recovered. A certain amount of waste is unavoidably mixed with the rock going to the mill, but it is only harmful in that it requires a larger amount of the expensive limestone to regulate the mix.

Considering the nature of the overburden and its amount, the fact that 98% of the material shot down can be recovered, that high and long working faces are possible, the open-pit method and the use of power shovels is logical and economical.

Drainage

The present quarry floor is on the same level as the mill site, but it is low with respect to the surrounding country. The maximum height of the quarry face above this level is 120 ft. However, due to the proximity and greater depth of other quarries, no drainage is necessary at present in the Reliance quarry. When the supply of cement rock above the present floor level is exhausted and if it is decided to sink deeper so as to recover the good rock below, it will then be necessary to provide for drainage.

Stripping

Stripping operations are carried on between April and October. The first cut is made with a Bucyrus steam shovel with a ¾-yd. dipper. This is followed later by a Marion steam shovel which has been converted into a dragline scraper and equipped with a ¾-yd. Page scraper bucket. Most of the clay is found in wide chasms and long crevices and the dragline is very suitable for removing it. In the narrow lateral crevices which are inaccessible to the scraper bucket, several men are employed to dig the clay and shovel it into the path of the bucket. All overburden is removed as far as possible.

The clay is loaded directly into Easton side-dump cars. The cars hold 1¼ cu. yd. and are hauled to the No. 1 waste dump by Vulcan steam locomotives. A train consists of six cars. The dump is located on the slope of a hill. The length of haul from the stripping area to the dump is between 1500 and 2000 ft.; the grade is less than 2%. The track layout is shown in Fig. 1. The gage is 30 in. and a 24-lb. rail is used.

The average amount of overburden removed in 10 hours is 175 cu. yd.; this figure applies to the dragline operation in which the stripping is tedious and expensive due to the awkward position of the clay. The dragline scraper and two locomotives are used at present. The stripping crew consists of 14 men as follows: Two men on the dragline, one man on each locomotive, six pick-and-shovel men to supplement the scraper and four men on the waste dump to empty cars and level off. One foreman has charge of stripping, drilling and prospecting.

The total cost of stripping over a period of four years amounts to $0.599 per cu. yd.

Stripping operations are kept well ahead of drilling, and enough rock to supply the mill for about two years has been stripped.

Mining

In mining, the general plan is to develop long and high faces so as to bring down with one shot sufficient rock to supply the

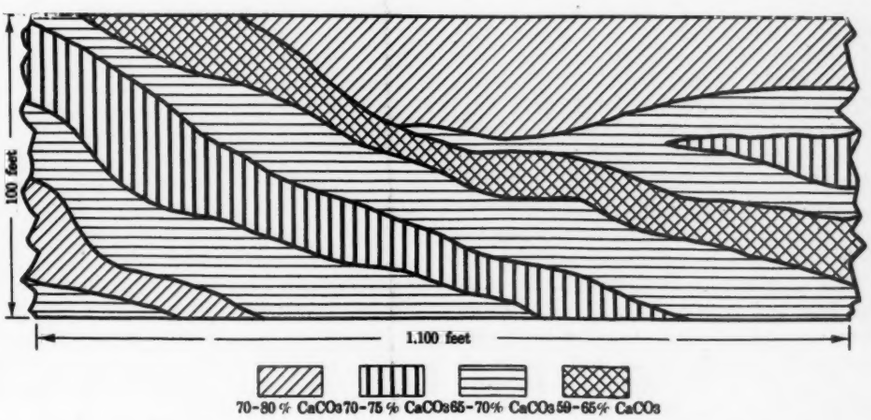


Fig. 3. Longitudinal section of rock below quarry floor

mill for several months. The Reliance mill requirements are between 25,000 and 30,000 long tons per month. The Central mill, when operating, requires about 18,000 tons per month. Both mills are supplied from the Reliance quarry. All the rock is used in the manufacture of cement. Waste inclusions amount to about 3% of the rock. About two-thirds of this can be easily segregated, loaded separately and transported to the No. 2 waste dump which is located close to the stripping dump but at a lower level on the side of the same hill. The haul to the lower waste dump is too steep to be made directly; it is accomplished by making one long level haul and three short hauls of 4% grade. The total length of haul from the quarry face to the lower waste dump is approximately 3500 ft.

The quarry face is perpendicular. From the east to the west side the height of the face increases from 85 to 110 ft. A circular face is developed. It is believed that this form of face gives the best blasting results with respect to the amount of explosives used per ton of rock for primary and secondary blasting.

Primary Drilling

Churn drills made by the Loomis Machine Co. are used for the primary drilling (and for prospecting). There are two gasoline drills, Model JA, one traction and one half-caterpillar and two steam drills, one traction and one horse-drawn. The gasoline drills are preferred, as they are found to be more economical to operate and are more convenient with respect to supplies, such as fuel and water. A horse and cart delivers the coal from the mill to the steam drills, dragline and to the locomotives. The driller's helper brings the gasoline in 5-gal. cans from the mill. A pipe line from the mill to the top of the quarry delivers either water or air. The air pressure is 65 lb. The air is used for operating an Ingersoll-Rand jackhammer when it is found necessary to blast some of the rock in order to level the surface or to fill in some of the crevices prior to locating the churn drill. Where the crevices are wide, the churn drill rests on a cribbing made from railroad ties.

Oil-well drill steel 5⅝ in. in diameter is used. Drill bits weigh 250 lb. and are dressed to 6⅛ in. diameter. Drill stems measure 4¼ in. by 20 ft. The bits are dressed in an Armstrong bit dresser. Casing is used only in clay or loose material.

The average drilling speed is 45 ft. per day of 10 hours. When in hard rock, bits have to be changed and dressed oftener so as to maintain a uniform diameter of the hole.

Holes are spaced 15 ft. apart, parallel to the face, and carry a 28-ft. burden. Where it is impractical, due to extreme irregularities of the top surface, to drill parallel to the face, the holes approach or recede from it, depending on the apparent degree of solidity of the rock at that point. Formerly it was the practice to increase the spacing in the more solid rock, but this procedure was discontinued, as it was found to make the cost of secondary blasting too high. The number of holes drilled for one shot ranges from 35 to 45. The diameter of the holes is 6¼ in.; the depth is governed by the height of the face, which varies from 85 to 110 ft. All holes are drilled 6 ft. below the quarry floor.

Drilling starts immediately after each shot is made. Positions of the holes are located by measuring from permanent stakes the exact distances toward the quarry face; this establishes the base line for the row of holes. A record is kept of the location of each set of holes and the position of each hole is plotted on a blue print of the quarry. Each hole is numbered. Samples are taken every 5 ft. and are marked according to the hole number and the depth at which the samples were taken. The samples are treated as described under "Methods of Analysis." They are stored until after the shot is made and the stone used. A composite is made of samples of all holes in the blast, and a complete analysis is made of it.

Primary Blasting

The explosives used for primary blasting are 60 and 40% gelatine dynamites. The cartridges are 5 in. in diameter and 24 in. long. Cordeau is used for detonating the charge. No. 6 detonators and Beaver fuse (speed 40 sec. per ft.) are used for firing.

The powder used for primary blasting is not kept in storage but is delivered to the quarry by auto trucks on the day the shot is to be fired. It is distributed to all the holes in proportion to the amounts and the strengths required. The boxes are opened by extra labor (not the loading crew). There are from two to four loading crews of three men each. They fill the holes in rotation and under the supervision of the explosive company's representative who acts as powderman and who is responsible for the shot.

In loading each hole the cordeau is attached to the bottom stick of powder. As a rule the bottom is loaded with the 60% powder and the top with 40%. The thickness of the burden at different heights also governs the distribution of the different strengths of explosive. When pockets are encountered, that portion of the hole is filled with clay. The holes are loaded to within 20 to 25 ft. from the top and the remainder is filled with clay and tamped down.

After all holes are loaded the ground is cleared of powder boxes and other obstructions, a trunk line of cordeau is run from the first to the last hole, and the free end of the line is connected to the detonator and fuse. The fuse is lighted with a match.

All holes are loaded and fired on the same day. Between 10 and 15 minutes are required to load each hole.

The fragmentation desired is dependent on the size of the primary crusher, which is 48- by 60-in. jaw type. There is no minimum limit, as all the stone is used for making cement.

In the drilling and blasting operations holes have been drilled with 16-ft. centers and 24 ft. of burden; 18-ft. centers and 26 ft. of burden; and different strengths of explosives, 30, 40, 50 and 60%, have been used under these varied conditions. The most economical results with respect to the total cost of primary and secondary blasting have been obtained by drilling the holes 15-ft. centers and carrying a 28-ft. burden.

Secondary Drilling and Blasting

Ingersoll-Rand jackhammers, Type BCR4, are used for drilling the large boulders. The air is delivered from the compressor to the quarry over a 2-in. line. Several 1¼-in. air lines branch out from the main line to different sections, and ¾-in. leads connect the main line to the drills. The air pressure at the drills is between 70 and 80 lb.

The drill steel is ⅞-in. hexagon stock; 1¼-in. bits are used for 1½-in. diameter holes, and 1¾-in. bits for 2-in. holes. In large boulders in which the depth of the holes exceeds 10 ft., the holes are made 2 in. in diameter; shallower holes are made 1½ in. in diameter. The drilling speed is about 1 ft. in 4 minutes.

The large boulders encountered by the steam shovels are cast to one side and drilled by a crew of two men used for this purpose and for barring down loose boulders which are also drilled. Holes are drilled to the centers of the boulders. The dynamite used is 1¼-in. diameter 40% gelatin. No. 6 detonators and Beaver fuse (speed 40 sec. per ft.) are used for firing. The holes are filled to within 2 in. of the top with the powder, the cap and fuse are attached to the last stick, and the last 2 in. of the hole is filled with clay and tamped well. The fuses are cut to not less than 30 in. and are lighted with a wick.

In primary blasting the shots will average 3.7 tons per lb. of explosive; in secondary blasting the ratio is approximately 1 lb. of explosive to 44 tons of stone.

Loading Stone

Two Bucyrus No. 70 traction-type steam shovels are used for loading the stone. The dippers are 2½-yd. capacity. One Bucyrus No. 65 is held in reserve. Two shovels are able to load between 180 and 190 long tons per hour; this includes the intermittent stops caused by transportation delays. There are three men on each shovel; an engineer, a fireman and a craneman. Working eight hours and five days per week, the mill requirements of from 25,000 to 30,000 long tons per month can be supplied.

Transportation

Three Vulcan steam locomotives running on standard gage 60-lb. rail are used to transport the rock to the crusher. The grade to the crusher is practically level. Atlas 10-ton side-dump cars are used. The

load in each car is 7½ long tons. Five cars make up a trainload. The fuel used on the locomotives, shovels, etc., is run-of-mine coal. It is hauled by a horse and cart to the shovels from a storage pile located on the track adjacent to the pump house. The locomotives obtain their coal from the same source. The water for the boilers is treated by the lime-soda process.

From the crusher to the quarry face the locomotives follow the horseshoe track around the face and make the return trip with the load over the straight piece of track (ST, Fig. 1). The cars receive half of their load from the shovel nearer to the mill and the load is completed by the further shovel. The loading system helps to mix the rock and reduces the variation in the composition. The haul to the crusher is about 1200 ft.

The total quarry crew (exclusive of the men on primary drilling, blasting and stripping) consists of 17 men; three on each shovel, one man on each locomotive, two powdermen for secondary drilling and blasting and for barring down, two pitmen, two track repairmen, one man at the crusher to dump cars and one foreman.

Crushing Plant

The primary crusher is located below the level of the tracks and rests on a solid rock foundation. Fig. 4 is a sectional view of the silos and the crushing equipment.

A small drum hoist geared to a 15-hp. motor is used for unloading the cars. The lift is applied through an overhead block and tackle. The cars are dumped directly on to a 5- by 12-ft. Traylor Sheridan grizzly feeder which is driven by a variable-speed 25-hp. motor. The feeder has a reciprocating motion and carries the rock ahead slowly and uniformly to a 48- by 60-in. Traylor jaw crusher belted to a 200-hp. motor. The fines, 3 in. and under, pass through the grizzly bars. The by-passing of the fines which contain most of the clayey material prevents choking of the crusher. The capacity of the primary crusher is 250 tons per hour crushing to 8 in.

The crushed product and the fines which pass the grizzly are picked up by a 48-in. by 60-ft. Link-Belt bucket elevator and delivered to the secondary crusher, a 42- by 48-in. Jeffrey swing-hammer mill directly connected to a 200-hp. motor. No intervening storage bin is required. The Jeffrey mill is very efficient for crushing cement rock. In order to reduce dust losses in the dryer stack several of the mill hammers have been removed.

The Jeffrey product, 3 in. and under in size, drops through a side chute to the lower run of a Link-Belt carrier which is driven by a 50-hp. motor. The buckets are 30 by 36 in. and overlap each other. The capacity

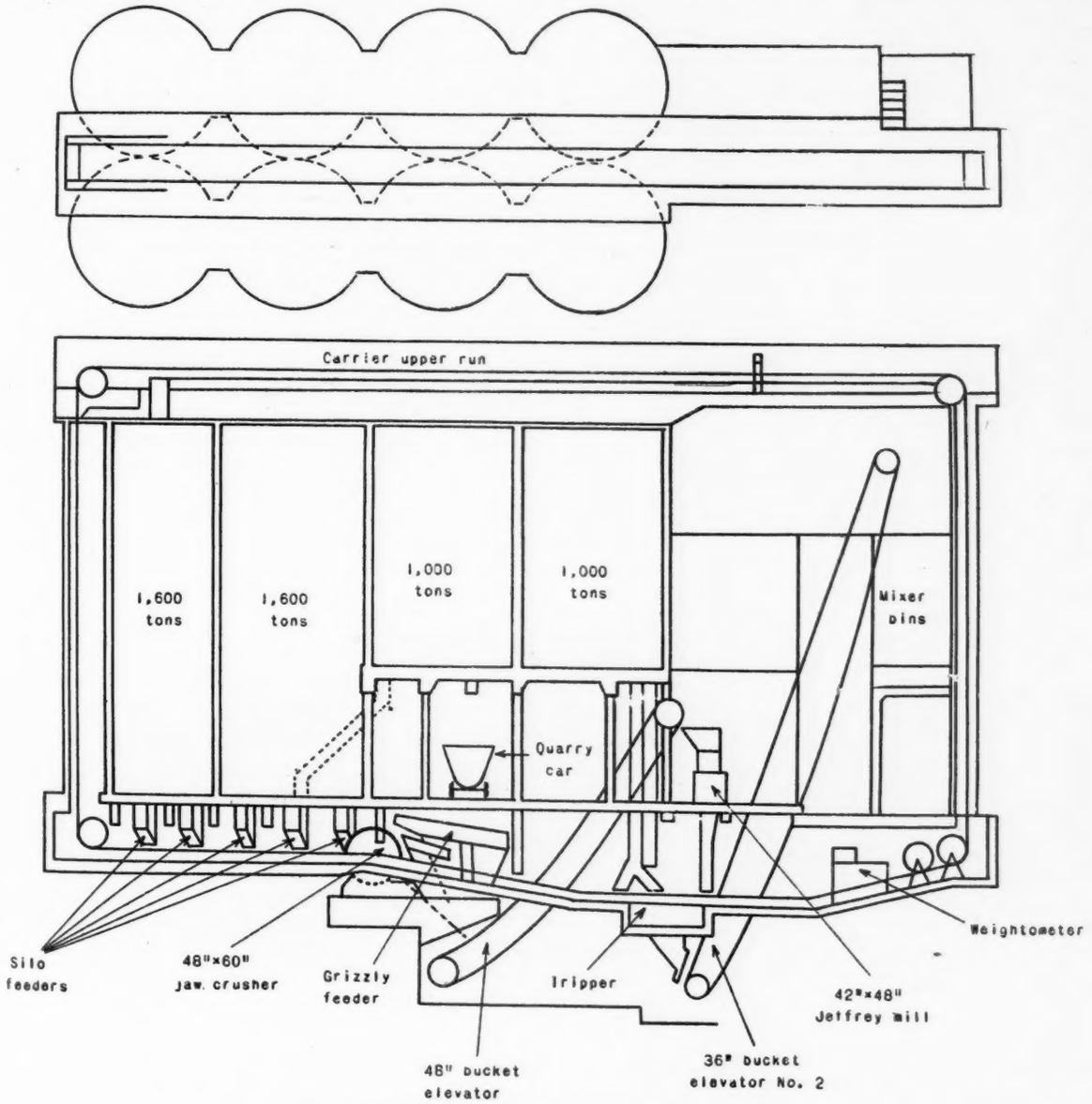


Fig. 4. Sectional view of silos and crushing plant

of the carrier is 300 tons per hour. The carrier passes over a Merrick weightometer which weighs and records the quantity of rock going to the storage silos.

There are eight round concrete silos (two rows of four) with an interstitial row star shaped. The storage capacity is 12,000 tons. One section of the silos is 65 ft. deep (inside depth) and the other is 40 ft. deep. The latter is built over the railroad tracks, and double duplex gates 24 by 24 in. are attached to the bottom of these four silos. This permits the crushed rock to be loaded into gondolas and shipped to the Central mill of the company.

A traveling tripper is used for dumping the carrier buckets containing the crushed rock into any of the silos. A small back-geared drum hoist driven by a 2-hp. motor pulls the tripper in a counter direction to that of the carrier; the forward movement is effected by the pull of the buckets.

The empty buckets descend at the rear end of the silos and travel through a tunnel under the latter. Under each silo there is a Link-Belt, reciprocating feeder. The feeders are driven through chain drives and clutches from a line shaft which is driven by a variable-speed 10-hp. motor. They can be adjusted to withdraw the rock at a uniform rate from any number of silos at the same time. By feeding from several silos simultaneously the rock is blended and the combined flow of material is more uniform in composition than that which entered the silos.

The feeders deliver the rock to the lower run of the carrier which conveys it to a point ahead of the secondary-crusher discharge chute. At this point a tripper dumps the blended rock into the boot or pit of a 36-in. by 96-ft. Link-Belt bucket elevator (elevator No. 2, Fig. 4) driven by a 40-hp. motor. The empty carrier buckets travel a few feet forward and pick up the product of the secondary crusher as already described. In case of a shut-down of the carrier the product of the secondary crusher or the crushed rock in the two north end silos can be fed directly to the No. 2 elevator, which delivers the rock to the mixer bins.

In the crushing department there are five men and a foreman. The three silo men, one on each eight-hour shift, keep the mixer bins supplied with cement rock and limestone; the latter is stored in two of the silos. One man operates the upper tripper (which distributes the rock to the silos) and collects an average daily sample of the rock from the carrier buckets. The sixth man helps in the unloading of cars of limestone and does odd jobs.

Drying and Mixing

There are two reinforced-concrete mixer bins each having a capacity of 200 tons. One is used for cement rock and the other for the crushed limestone. The mixing room is located under these bins. Here the cement rock and the limestone are proportioned to make the raw cement mixture. The bins are equipped with duplex gates through which the stone feeds into the hopper of the Toledo scale. The hopper is drop-bottom and discharges at a uniform rate to a horizonal belt conveyor, 39 in. by 7 ft. 3 in., which carries the mixture to a 16-in. by 35-ft. overlapping bucket elevator. The latter delivers the product to another horizontal belt conveyor 36 in. by 14 ft., to be discharged into the cylindrical dryer. The head pulley of the latter conveyor is a 16-in. diameter magnetic separator which picks the tramp iron from the stone.

The dryer, 8 by 80 ft., is direct fired by pulverized coal and can dry 67 tons per hour. Between 1100 and 1300 tons are dried each 24 hours. The dryer, the bucket elevator, the belt conveyors and the auxiliary conveying equipment for cleaning the dryer stack chamber are driven by a 75-hp. motor through a Cleveland Worm and Gear Co. speed reducer.

The dryer discharges directly into a 42-by 48-in. Jeffrey hammer mill direct-connected to a 75-hp. motor. Originally this mill was one of two installed for secondary crushing. One was found to be sufficient and the other was used to replace a smaller type of hammer mill at the discharge end of the dryer. The main purpose of this tertiary crushing is to break any stray large lumps of stone. The rock is reduced to under 1-in. size and discharges into an inclosed 17-in. by 40-ft. bucket elevator which elevates it to a large rectangular steel bin located over the preliminary grinding mills. The bin has a capacity of about 100 tons.

There are three men in the mixing department, one man on each shift of eight hours. There are no men in the drying department. The dryer, once started, requires little attention and that is given by the men in the grinding department.

Grinding

The preliminary grinders are two Bradley Hercules mills. Each is direct-connected to a 300-hp. synchronous motor. The mills are equipped with 9-mesh screens and have an output of 40 long tons per hour per mill.

SCREEN ANALYSIS OF HERCULES MILL PRODUCT

Mesh	Per cent. undersize
200	54.2
100	62.4
80	68.1
50	75.0
30	88.2
20	98.5
10	100.0

The ground material discharges into a 24-in. by 45-ft. bucket elevator. The latter discharges into a 24-in. by 60-ft. screw conveyor which distributes the material into a steel blending bin. The elevator and conveyor are chain-driven from a Palmer-Bee speed reducer coupled to a 25-hp. motor. There are five discharge openings in the conveyor casing. The first four are equipped with steel slides which are operated by an electrical device that opens and closes them in rotation. This insures a uniform distribution of the material entering the blending bin. The lower section of the bin consists of five hoppers, the centers of which are directly under the conveyor openings. Under the hoppers there are five rotary valves driven through chain drives from a line shaft. The valves withdraw the mix from the bin at a uniform rate and the five streams feed into an 18-in. by 50-ft. screw conveyor. This discharges into a 17-in. by 25-ft. bucket elevator which in turn discharges into an 18-in. by 66-ft. screw conveyor which feeds the tube mills. The valves, the two 18-in. screw conveyors, and the last elevator are all driven by a 25-hp. motor through a Palmer-Bee speed reducer.

There are two tube mills for the final grinding of the raw mix. One is a 7- by 26-ft. Traylor and the other is a No. 20, 7-ft. by 23- ft. 6-in. Smidth. The former is driven by a 500-hp. synchronous motor; the latter by a 400-hp. synchronous motor. The mills are charged with ¾-in. steel balls and cylpebs. The charge in the large mill is 35 tons; in the smaller mill 24 tons. The combined output of both mills is about 50 tons per hour; 90% of the product passes a 200-mesh screen.

The grinding department operates 24 hours per day, 7 days per week. Six men, two on each 8-hour shift, are employed in this department.

Repair Shop

There is a large and well-equipped repair shop at one end of which is the blacksmith's shop. A 12- by 10-in. class 38, Pennsylvania Pump and Compressor Co. compressor supplies the air for the jackhammers and for miscellaneous purposes. An Armstrong bit dresser for the well-drill bits and a Denver Rock Drill Co. bit dresser for the air-drill bits are part of the blacksmith shop equipment.

Repairs on the shovels and the locomotives are made without delay. The men operating these units work on a bonus system and the equipment for mining and transportation is kept in good condition at all times. All boilers are cleaned out every two weeks.

Power

Electrical power is purchased from the Pennsylvania Power and Light Co. The sub-station equipment consists of two 3000-kva. transformers and two 100-kw., 220-volt, direct-current motor generators. The incoming power is stepped down from 66,000 to 440 volts.

Pay System

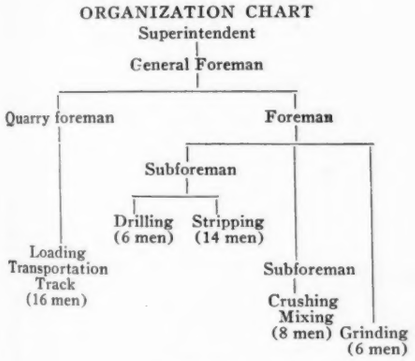
The men employed on stripping, primary drilling and blasting and in the crushing and grinding departments are paid a straight hourly wage. The crew engaged in transportation, loading and unloading of the cement rock is paid an hourly wage and a bonus. There are 16 men included in the

bonus distribution. The bonus is based on a fixed labor cost and the actual labor cost for transportation, loading and unloading. A maximum labor cost of 8 c. per long ton is the present fixed standard. The difference between the maximum and the actual labor cost is paid to the men.

The wage scale is as follows:

Position	No.	Rate per hour
Shovel engineers	3	$0.53
Shovel firemen	3	0.47
Shovel cranemen	3	0.48
Well drillers	3	0.495
Well drillers' helpers	3	0.425
Drillers (jackhammer)	2	0.505
Pitmen	2	0.45
Locomotive engineers	5	0.51
Trackmen	2	0.465
Men on waste dump	4	0.40
Pick and shovel men on stripping	6	0.40
Blacksmith	1	0.60
Tripper man (mill)	1	0.45
Silo men	3	0.46
Mixer men	3	0.425
Millers	3	0.58
Millers' helpers	3	0.53
Subforemen	2	0.58

ORGANIZATION CHART



COSTS

	Period covered, 1929
Production of stone (short tons)	288,528
Overburden removed (cubic yards)	26,956

1. Summary

	Cost per ton
Stripping	$0.05599
Primary drilling and blasting	.06606
Secondary drilling and blasting	.00855
Loading	.07454
Transportation	.05258
Primary and secondary crushing and storage	.07720
Drying, mixing, tertiary crushing and grinding	.36378
Total	$0.69870

2. Stripping

Labor	$0.03627
Purchased power	.00004
Fuel	.00467
Other supplies	.01500
Total	$0.05598

3. Primary drilling and blasting

Labor	$0.01015
Explosives	.04571
Fuel	.00206
Other supplies	.00814
Total	$0.06606

4. Secondary drilling and blasting

Labor	$0.00600
Explosives	.00250
Other supplies	.00005
Total	$0.00855

5. Loading stone (shovels)

Labor:	
Operating	$0.02200
Repair	.00450
Pitmen	.00560
Cleaning quarry	.00088
Teaming	.00375
Foreman	.01082
Purchased power	.00030
Fuel	.00973
Other supplies	.01696
Total	$0.07454

6. Transportation

	Cost per ton
Labor:	
Operating locomotives	$0.02140
Repairing locomotives	.00481
Repairing tracks	.00239
Moving tracks	.00965
Repair material:	
Locomotives	.00346
Tracks	.00155
Moving tracks	.00032
Purchased power	.00030
Fuel	.00766
Oil and waste	.00104
Total	$0.05258

7. Primary and secondary crushing and storage

Labor:	
Operating	$0.04168
Repairs	.00293
Supplies:	
Operating	.00033
Repairs and maintenance	.01045
Oil and waste, tools	.00745
Fuel	.00063
Purchased power	.01373
Total	$0.07720

8. Drying, mixing, tertiary crushing and grinding

Labor:	
Operating	$0.05449
Repair	.03649
Supplies:	
Operating	.00062
Repairs and maintenance	.03158
Tools	.00007
Fuel	.02947
Oil and waste	.00753
Purchased power	.20353
Total	$0.36378

10. Man-hours

	Man-hours per ton	Tons per man hour
Stripping and drilling	0.13900	7.19
Loading and transportation	.12608	7.93
Crushing	.11696	8.55
Drying and grinding	.17914	5.58

9. Summary of cost distribution

	Labor	Power	Fuel	Explosives	Other supplies	Total
Stripping	$0.03627	$0.00004	$0.00467	.....	$0.01500	$0.05598
Primary drilling and blasting	.01015	.....	.00206	$0.04571	.00814	.06606
Secondary drilling and blasting	.00600	.....	.....	.00250	.00005	.00855
Loading stone	.04755	.00030	.00973	.....	.01696	.07454
Transportation	.03825	.00030	.00766	.....	.00637	.05258
Primary crushing	.....	.00574	.....	.....	.....	.....
Secondary crushing	.....	.00348	.....	.....	.....	.....
Storage in	.....	.00180	.....	.....	.....	.....
Storage out	.04461	.00271	.00063	.....	.01823	.07720
Mixing, drying	.....	.01864	.....	.....	.....	.....
Tertiary crushing	.....	.00401	.....	.....	.....	.....
Prelim. grinding	.....	.04963	.....	.....	.....	.....
Final grinding	.....	.12824	.....	.....	.....	.....
Conveying, etc.	.09098	.00301	.02947	.....	.03980	.36378
Totals	$0.27381	$0.21790	$0.05422	$0.04821	$0.10455	$0.69869

Milwaukee Newspaper Worried About Michigan Sand Dunes

ARE THE HISTORICAL SAND DUNES of Lake Michigan, which belong to the natural wonders of the world, to give way to the demands of industry?

That is a question which is worrying residents of western Michigan and thousands of nature lovers who make annual pilgrimages to enjoy the beauties of the dunes, says *The Milwaukee Journal.*

The invasion of industry into the dunes started several years ago, unnoticed and unprotested. However, today more and more of these great dunes are being attacked by the steam shovels, and boatload by boatload, carload by carload, are being carted away to distant cities, where the sand is being used in industrial enterprises.

Every year finds the demand increasing for the pure Lake Michigan sand, which is of a quality suitable for use in foundries, blast furnaces, the manufacture of glass and many other lines of industry.

In Muskegon, however, and in other parts of western Michigan, where lumber was once king, the residents cannot help but remember that the same thing was said many times regarding the countless acres of the choicest white pine tracts in the world.

Pigeon Hill, Muskegon's foremost sand dune, known throughout the country, has stood for ages overlooking and protecting the Muskegon Harbor.

Now, day by day, a steam shovel is slowly eating away Pigeon Hill, loading it in a boat and moving it away to a distant foundry.

Muskegon waged a battle to save Pigeon Hill, but in the end it ost. It closed every avenue of removal as far as land was concerned, but it could not prevent its removal by water.

Pigeon Hill was looked upon as an institution, owned by the people. No one gave its future a thought, but one day the awakening came. The Nugent Sand Co. obtained title and announced plans to remove it.

Sets Off Large Blast

TWENTY-SIX and a quarter tons of dynamite planted in the rock walls of the Connecticut Quarry Co. (New Haven, Conn.) trap rock quarry at Reed's Gap was set off in one charge April 14 breaking up solid rock estimated at a quarter of a million tons, enough to supply the quarry company for a year.

It was one of the largest blasts of dynamite ever exploded in Connecticut.

The dynamite was packed in two tunnels, one above the other, reaching 52 and 58 ft. into the rock at right angles to the face of the quarry.—*Westerly* (R. I.) *Sun.*

Researches on the Rotary Kiln in Cement Manufacture*

Part XVIII—Proof That the Clinker Output Per 1 Lb. of Coal Burnt Is Greatest When the Flame Temperature Is Highest, and That the Output of Clinker Must Diminish When Air in Excess of 10.478 Lb. Per 1 Lb. of Standard Coal Is Supplied to the Kiln

By Geoffrey Martin

D.Sc. (London and Bristol), Ph.D., F.I.C., F.C.S., M. Inst. Chem. Eng., M. Inst. Struct. Eng., M. Soc. Pub. Analysts, F. Inst. Fuels; Chemical Engineer and Consultant; Former Director of Research of the British Portland Cement Research Association; Author of "Chemical Engineering"

Abstract

THIS INSTALLMENT will prove rather difficult reading because it consists practically entirely of thermodynamical and mathematical proof of the author's proposition stated in the subhead above.

This may seem inconsistent with the previous installment, but the analysis given there, and repeated here, was for an ideal condition not attained in practice.

The conclusions given here are easily read, and the reader who wants the author's proof really will have little difficulty following through his reasoning and mathematics.

The point chiefly emphasized is that unless flame temperatures can be increased the limits set to kiln economy are narrow.

And of course there are practical limits to the increase in flame temperature, as the author points out, and as he will develop in future installments.—The Editor.

IN Part XV we showed that the weight of clinker produced depends upon the quantity of heat Q contained in the gases of combustion evolved from the combustion of 1 lb. of coal, and that in general the higher the initial flame temperature the greater the clinker output.

In the whole chapter, however, it is assumed that the air supplied to the kiln is that necessary for normal combustion—viz., 10.478 lb. of air per 1 lb. of standard coal consumed.

It is the purpose of this chapter to prove that any quantity of air supplied beyond 10.478 lb. per 1 lb. of coal must necessarily diminish the clinker output except in one particular case, which so far has not been attained in practice and which will be discussed below.

To prove that the maximum output of clinker per 1 lb. of coal burnt is attained when 10.478 lb. of air are supplied per 1 lb. of standard coal, and that any excess of air beyond this lowers the clinker output per 1 lb. of coal burnt.

Assume the clinkering temperature of the material to be 2500 deg. F. and the temperature of the atmosphere to be 60 deg. F. Let W_1 lb. of clinker be produced per 1 lb. of standard coal consumed when the air supply is the normal one of 10.478 lb. per 1 lb. of coal burnt. The weight of combustion gases produced is 11.278 lb. per 1 lb. of coal (see Part XI). Let t_1 deg. be the temperature of the 10.478 lb. of entering air when it meets the coal. It is assumed that the W lb. of outgoing clinker has given up all its heat to the incoming 10.478 lb. of air, which would be the case in a perfect kiln.

Hence t_1 deg. is always less than 2500 deg. F.

Let T_1 be the flame temperature attained when the 10.478 lb. of air at t_1 deg. F. unite with 1 lb. of coal.

Let S_1 be the mean specific heat of the furnace gases between T_1 and 1481 deg. F. —the temperature at which the $CaCO_3$ decomposes (see Part VIII).

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Then the B.t.u.'s evolved when 11.278 lb. of combustion gas sink from T_1 deg. to 1481 deg. F. are:

$$Q_1 = 11.278 \times S_1 \times (T_1 - 1481) \quad . . (1)$$

also the weight of clinker W_1 is given by (see Part XV):

$$W_1 = \frac{Q_1}{918.6} \quad . . . . (2)$$

Let S_2 be the mean specific heat of the 10.478 lb. of entering air between 60 deg. and t_1 deg. F., and S_3 the mean specific heat of the clinker between 2500 deg. and 60 deg. F.

Then the temperature t_1 of the entering air is given by:

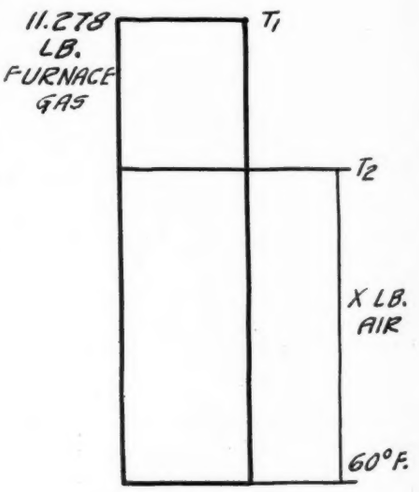
$$10.478 \times S_2 \times (t_1 - 60) = W_1 \times S_3 \times (2500 - 60) \quad . . (3)$$

$$= \frac{Q_1}{918.6} \times S_3 \times 2440$$

$$= 2.656 Q_1 \times S_3,$$

whence $$t_1 = 0.2535 Q_1 \times \frac{S_3}{S_2} + 60 \quad . . . (4)$$

Now let an additional X lb. of air be supplied to the kiln. This air will come in cold because all the heat has been already abstracted from the clinker by the 10.478 lb. (so that t_1 is kept unchanged while the other X lb. of air enters at 60 deg. F.). Let the new flame temperature be T_2 and the new mean specific heat of the furnace gas between T_1 and T_2 be S_4, and let the mean specific heat of air between 60 deg. and T_2 be S_5.



Heating of cold air by furnace gas

Then we have 11.278 lb. of furnace gas sinking from T_1 to T_2 will heat X lb. of air from 60 deg. to T_2.

So that

$$11.278 \times S_4 \times (T_1 - T_2) = X \times S_5 \times (T_2 - 60),$$

or

$$T_2 (X \times S_5 + 11.278 \times S_4) = T_1 \times 11.278 \times S_4 + 60X \times S_5,$$

or

$$T_2 = \frac{11.278 \times S_4 \times T_1 + 60 X \times S_5}{X \times S_5 + 11.278 \times S_4} \quad . . (5)$$

We have now 11.278 lb. of combustion gas at T_2 deg. F. and X lb. of air at T_2 deg. F., and this mass of gas sinking from T_2 deg. to 1481 deg. F. will liberate an amount of

heat Q_2 which will be available for forming the new weight of clinker:

$$W_2 = \frac{Q_2}{918.6} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Then we must show that the new amount of heat Q_2 evolved is *less than* the old *amount* Q_1, in order that W_2 may be less than W_1.

Now

$$Q_2 = 11.278 \times S_6 \times (T_2 - 1481) + X \times S_7 (T_2 - 1481),$$

where S_6 and S_7 is the mean specific heat of the combustion gases and of air between T_2 deg. and 1481 deg. F.,

or

$$Q_2 = T_2 (11.278 \times S_6 + X \times S_7) - 1481 (11.278 S_6 + X \times S_7).$$

Now substitute value of T_2 from (4) and we see

$$Q_2 = \left(\frac{11.278 S_6 + X \times S_7}{11.278 S_4 + X \times S_5}\right) T_1 \times 11.278 \times S_4 + 60X \times S_5 \left(\frac{11.278 S_6 + X \times S_7}{11.278 S_4 + X \times S_5}\right) - 1481 (11.278 S_6 + X \times S_7) \quad . \quad (7)$$

and from (1)

$$Q_1 = 11.278 S_1 T_1 - 1481 (11.278 S_1) \quad . \quad (8)$$

whence

$$Q_1 - Q_2 = T_1 \left(11.278 S_1 - \frac{11.278 S_6 + X \times S_7}{11.278 S_4 + X \times S_5} \times 11.278 \times S_4\right) - 1481 (11.278 S_1 - 11.278 S_6) + 1481 X \times S_7 - 60X \times S_5 \frac{11.278 S_6 + X \times S_7}{11.278 S_4 + X \times S_5}$$

S_1, S_2, S_3, S_4, S_5, S_6 and S_7—the specific heats of the air, combustion gases, and clinker at temperatures above 1481 deg. F.—are all very nearly equal.

Whence, putting $S_1 = S_2 = S_3 = S_4 = S_5 = S_6 = S_7 = 0.3$, we get

$$Q_1 - Q_2 = 1481 \times S_1.$$

Now S_1, the specific heat, is essentially a positive number, and X, the excess air, added to the 10.478 lb., can only vary from 0 to a positive number.

Hence $Q_1 - Q_2 >$ a positive number,

or $$Q_1 > Q_2.$$

Consequently, Q_2 is always less than Q_1 when X is greater than zero.

But $$W_2 = \frac{Q_2}{918.6} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

and $$W_1 = \frac{Q_1}{918.6} \quad . \quad . \quad . \quad . \quad . \quad (10)$$

Hence $W_1 > W_2$ whenever X is greater than 0.

Substituting in (7)

Therefore $$W_1 - W_2 = \frac{1421}{9186} \times X \times S_1. \quad . \quad . \quad (11)$$

Now, taking S_1 as approximately 0.3 for high temperatures, we get

$$W_1 - W_2 = \frac{1421 \times 0.3}{918.6} . X$$

$$W_1 - W_2 = 0.46X \text{ approximately} \quad . \quad (12)$$

or $$W_2 = W_1 - 0.46X \quad . \quad . \quad . \quad (12a)$$

which shows that in general the greater is X—the excess air over 10.478 lb.—the greater is the loss in clinker output. This proves the proposition.

Of course, (12) is only an approximate formula, but is useful in approximately calculating the diminution of output in clinker caused by increasing the air supply. For ordinary kilns—when the flame temperature is only about 2600 deg. F.—S_1 may be taken as 0.252,

whence $$W_1 - W_2 = 0.4X,$$

or $$W_2 = W_1 - 0.4X.$$

Hence, so long as t_1—the temperature of the entering air heated by the clinker—is *below* the clinkering temperature 2500 deg. F., the clinker output is greatest when $X = 0$, *i.e.*, when only 10.478 lb. of air are supplied per 1 lb. of standard coal.

But under these conditions it was proved in Part XV that the clinker output is greater the *higher the flame temperature.* So that we have arrived at a conclusion of *vital importance* in kiln design, namely:

The higher the flame temperature attained in the clinkering zone, the greater the possible output of clinker per 1 lb. of coal burnt.

By no possible manipulation (such as introducing excess of air) is it possible *to reduce the flame temperature in the clinkering zone without simultaneously reducing the clinker output per 1 lb. of coal burnt.*

A greater weight of colder furnace gas will never prove so efficient in producing clinker as a smaller weight of very hot gas.

On account of the very great practical importance of the above principle we will work out in detail some examples showing the decrease in clinker output which follows an increase in the supply of air beyond 10.478 lb. per 1 lb. of coal burnt.

Example.—*In a perfect kiln using* 10.478 *lb. of air per* 1 *lb. of coal and producing* 9.311 *lb. clinker per* 1 *lb. of standard coal fired, the temperature of the entering air (preheated by the clinker so as to abstract all its heat) is* 2236 *deg. F. and the flame temperature is* 3916 *deg. F.*

Trace the effect on the clinker output if the air supply is increased from 10.478 to 13.478 lb. per 1 lb. of coal.

Here $X = 3$ lb. (= weight of air in excess of 10.478 lb.).

$$W_1 = 9.311.$$

Hence from equation (12), therefore

$$W_2 = W_1 - 0.46X = 9.311 - 0.46 \times 3 = 9.311 - 1.380 = 7.931 \text{ lb.}$$

So that the effect of increasing the air supply by 3 lb. per 1 lb. of air would be to diminish the clinker output from 9.3 to 7.9 lb.

Let us now check this result by carrying the calculation through from first principles. The flame temperature when only 10.478 lb. of gas are present is 3916 deg. F. The B.t.u. evolved when 11.278 lb. of combustion gas sink from 3916 to 1481 deg. F. is 8553 B.t.u., corresponding to the clinker weight of 9.311 lb. per 1 lb. of coal burnt.

On now adding 3 lb. of cold air to the entering air (making 13,478 lb. of air in all) we must have 11.278 lb. of furnace gas sinking from 3916 deg. F. to the new flame temperature T deg., heating 3 lb. of air from 60 deg. to T deg.

Taking the mean specific heat of air between 60 deg. and 3000 deg. F. as 0.2583, and taking the mean specific heat of the furnace gas between 60 deg. and 3000 deg. F. as 3053, then we have

$$11.278 \times 0.3053 \times (3916 - T) = 3 \times 0.2583 \times (T - 60),$$

or $T = 3208$ deg. F. as the new flame temperature of the diluted mass of gas.

The mean specific heat of the combustion gas between 1481 deg. and 3208 deg. F. is 0.3018 deg. F., and that of air under the same circumstances is 0.275.

Then we have 11.278 lb. of combustion gas at 3208 deg. F. + 3.0 lb. of air at 3208 deg. F. sinking to 1481 deg. F.—the temperature at which the $CaCO_3$ decomposes—will evolve

$$11.278 \times 0.3013 \times 1727 + 3 \times 0.275 \times 1727 = 7293 \text{ B.t.u.},$$

which are available for clinker formation under the new circumstances.

So that the new amount of clinker formed will now be $\frac{7293}{918.6} = 7.93$ lb.

In other words, the addition of 3 lb. of air to the 10.478 lb. entering the kiln per 1 lb. of coal burnt has lowered the clinker output per 1 lb. of coal fired from 9.311 to 7.93 lb. This thus checks our former result.

Exceptional case when the temperature of the incoming air is preheated to 2500 *deg. F. (the clinkering temperature) by the clinker, and when the kiln is producing over* 10.54 *lb. of clinker per* 1 *lb. of coal burnt.*

In Part XVII, it was shown that, if a kiln was constructed so as to yield anything between 10.54 and 15.732 lb. of clinker per 1 lb. of coal burnt (or 100 tons clinker per 9.49 to 6.36 tons of standard coal of 12,600 B.t.u. per 1 lb.), it would be possible to feed the coal with air in excess of that needed for normal combustion (viz., 10.478 lb. air per 1 lb. of coal), all this air being preheated by the clinker to 2500 deg. F. (1371 deg. C.) (the clinkering temperature) by the outgoing clinker, and when the theoretical limit of clinker production was reached (viz., 100 tons of clinker for 6.36 tons of standard coal consumed, or 15.732 lb. of clinker per 1 lb. of standard coal consumed), it would then be possible under these circumstances to supply no less than 5.171 lb. of excess air thus heated to each 1 lb. of coal consumed—a very large amount of hot air, for, since 1 lb. of coal only requires 10.478 lb. of air, the excess air would be

$$\frac{5.171}{10.478} \times 100 = 49.3\%,$$

i.e., nearly 50% in excess of that needed for

normal combustion. The reader should consult Part XVII.

It was shown in Part XVII that under the above circumstances, if the supply of hot air to the kiln was restricted to 10.478 lb. per 1 lb. of coal, the kiln could only produce 10.54 lb. of clinker. But if the supply of hot air was gradually increased from 10.478 to 15.649 lb., the *output of clinker would likewise increase from* 10.54 *to* 15.732 *lb. per* 1 *lb. of coal burnt.*

Hence this fact seems at first sight to contradict the conclusion above—that if the air supply be increased beyond 10.478 lb. per 1 lb. of coal, the output must diminish.

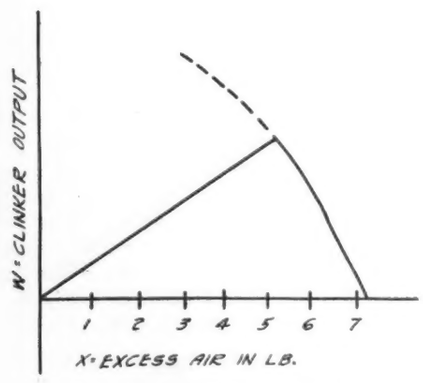
A closer examination of the theory, however, will show that this case is also included in the general one, consistent with the restriction of the value of t_1 (the temperature of the incoming air as preheated by the outgoing clinker to the point where it abstracts all the heat from the clinker) to 2500 deg. F., since no matter how much clinker is produced, the clinker cannot preheat the air to above 2500 deg. F., as this would mean that the air can be made hotter than the outgoing heating material, which is contrary to the second law of thermodynamics.

Consider now equation (3) on a preceding page, on which the above theory was built up. We have the following relationship for the temperature t, to which the given weight of air can be preheated by the outgoing clinker:

$$\left\{\begin{matrix}\text{Weight of entering}\\ \text{air per 1 lb. of coal}\end{matrix}\right\}\times\left\{\begin{matrix}\text{Mean specific heat of air between 60 deg. and } t \text{ deg. F.}\end{matrix}\right\}\times\left\{\begin{matrix}\text{Rise in temperature}\\ \text{of air}\end{matrix}\right\}$$
$$=\left\{\begin{matrix}\text{Weight of outgoing}\\ \text{clinker per 1 lb.}\\ \text{of coal}\end{matrix}\right\}\times\left\{\begin{matrix}\text{Mean specific heat of}\\ \text{clinker between 60}\\ \text{deg. and 2500 deg. F.}\end{matrix}\right\}\times\left\{\begin{matrix}\text{Fall in}\\ \text{temperature}\\ \text{in clinker}\end{matrix}\right\},$$

or, if X be the weight of air in lb. in *excess* of the normal weight 10.478 required for the combustion of 1 lb. of coal, and W be the weight of clinker produced per 1 lb. of coal burnt—

$$(10.478+X)\times\left\{\begin{matrix}\text{Mean specific heat}\\ \text{of air between 60}\\ \text{deg. and } t \text{ deg. F.}\end{matrix}\right\}\times(t-60)=W\times 0.2519\times(2500-60)\quad\ldots\quad(1)$$



Relation of clinker output to excess air

Now when the weight W of clinker reaches 10.54 lb. per 1 lb. of coal burnt, we have seen that $t=2500$ deg. F. (see Part XVII), and specific heat of air between 60 deg. and 2500 deg. F. becomes 0.2533.

So that (1) reduces itself to

$$(10.478+X)\times 0.2533\times(2500-60)=W\times 0.2519\times(2500-60),$$

or the factor $(2500-60)$ cancels out on both sides, and we get, *so long as* $t=2500$ *deg. F.*,

$$10.478+X=0.9945W\quad\ldots\quad(2)$$

This shows that, *so long as* $t=2500$ *deg. F.*, the weight W of the clinker will steadily increase with X—the weight of excess air. For example, if

$X=0$, $W=\dfrac{10.478}{0.9954}=10.54$ lb. of clinker.

$X=1$, $W=\dfrac{11.478}{0.9954}=11.5$ lb. of clinker.

$X=2$, $W=\dfrac{12.478}{0.9954}=12.5$ lb. of clinker.

$X=3$, $W=\dfrac{13.478}{0.9954}=13.5$ lb. of clinker.

$X=4$, $W=\dfrac{14.478}{0.9954}=14.5$ lb. of clinker.

$X=5.171$, $W=\dfrac{15.649}{0.9954}=15.7$ lb. of clinker.

(See Table III, Part XVII.)

But equation (2) is subjected to another restriction as well. W cannot exceed 15.732 lb. of clinker per 1 lb. of coal burnt (see Part XV) on account of the heat necessary to form the clinker and decompose the $CaCO_3$.

Hence the excess air X can only range from 0 to 5.171 lb., and within these limits the *yield of clinker* W per 1 lb. of coal burnt will increase from 10.54 to 15.73 lb. per 1 lb. of coal burnt.

If X increases beyond 5.171 lb., then the former law will come into operation and the clinker output will again begin to decrease with X.

It will be seen, therefore, that the new relationship holds only for the very special case for the brief range when the temperature of the incoming air is heated to the clinkering temperature 2500 deg. F., by the outgoing clinker, and is a direct consequence of the second law of thermodynamics—viz., that the air cannot be heated to a higher temperature than 2500 deg. F. by clinker issuing at 2500 deg. F.

From the preceding article it is clear that when the air supply increases beyond certain limits, the value of Q diminishes. It will be remembered that Q is the amount of heat available for clinker formation contained in the furnace gases above 1481 deg. F. It is, therefore, of interest to examine the values of X for which Q will become zero—*i.e.*, when clinker will cease to be formed when the excess air exceeds certain limits.

The calculations will be much simplified by assuming that the specific heats of the clinker, hot air and furnace gases are all equal to each other. This is sufficiently correct not to give misleading results. We will also take this specific heat to be equal to 0.30, as in most cases the gases are at a high temperature.

Let t deg. F. = the initial temperature of the air at the point where combustion commences.

T deg. = the flame temperature when the air is at t deg.

X = weight of air added (in lb.) in *excess* of that needed for normal combustion.

S = mean specific heat of gases between t deg. and T deg. = 0.30.

Then 11.278 lb. of combustion gas + X lb. of excess air at t deg. F. are raised to T deg. F. by 12,600 B.t.u. developed by the combustion of 1 lb. of standard coal.

Hence

$$\left(\begin{matrix}\text{Weight of}\\ \text{gas}\end{matrix}\right)\times\left(\begin{matrix}\text{Specific}\\ \text{heat}\end{matrix}\right)\times\left(\begin{matrix}\text{Rise of}\\ \text{Temperature}\end{matrix}\right)=\left(\begin{matrix}\text{B.t.u.'s available}\\ \text{for heating}\end{matrix}\right)$$
$$(11.278+X)\times 0.3\times(T-t)=12{,}600,$$

or

$$T=\frac{12{,}600}{(11.272+X)\times 0.3}+t\quad\ldots\quad(1)$$

The quantity of heat Q available for clinker formation is obtained by $(11.278+X)$ lb. of hot gas sinking from T deg. to 1481 deg. F. (the temperature of decomposition of the $CaCO_3$).

Hence $$Q=(11.278+X)\times 0.3\times(T-1481)\text{ B.t.u.'s}\quad\ldots\quad(2)$$

Now, substituting the value of T from (1), we get

$$Q=7589.19+3.3834t+0.3Xt-444.3X\quad\ldots\quad(3)$$

Now take the mean specific heats of the air and clinker between 60 deg. and 2500 deg. F. as being equal to each other and equal to 0.25, which is nearly true (see Part XVII).

Then

$$\text{Weight of clinker} \times \text{Specific heat of clinker} \times \text{Fall of temperature} = \text{Weight of entering air} \times \text{Specific heat of air} \times \text{Rise of temperature of air}$$

or $$\frac{Q}{918.6} \times 0.25 \times (2500 - 60) = (10.478 + X) \times 0.25 \times (t - 60),$$

which gives:

$$t = \frac{2.656Q}{10.478 + X} + 60 \quad \ldots \quad (4)$$

Now, substituting this value of t in (3), we get:

$$Q = \frac{81647 + 3325X - 426X^2}{1.492 + 0.2032X} \quad \ldots \quad (5)$$

From (5) we see there are two values of X which reduce Q to zero, these values being the roots of the quadratic equation:

$$426X^2 - 3325X - 81647 = 0,$$

whence $X = +$ 18.3 lb. nearly, or $X = -$ 10.5 lb. nearly.

In other words, if the normal air supply of 10.478—say, 10.5 lb.—of air per 1 lb. of coal is increased by 18.3 lb., making 10.5 + 18.3 = 28.8 lb. of air supplied per 1 lb. of coal, we would so reduce our flame temperature to nearly 1481 deg. F. and so render it impossible to form clinker (see Part XV), as this is the temperature of decomposition of the $CaCO_3$.

On the other hand, if we diminished our normal air supply by 10.5 lb. (*i.e.*, from 10.5 lb. per 1 lb. of air to 10.5 − 10.5 = 0 lb.), we would also stop clinker formation because the air supply would fail.

Let us examine equation (5) above more carefully.

$$\text{Here } Q = \frac{81647 + 3325X - 426X^2}{1.492 + 0.2032X} \quad \ldots \quad (5)$$

Put $X = 0$. Then Q = 54,723 B.t.u. What does this mean? On arriving at (5) it will be recollected that the values of t were left absolutely unrestricted, whereas in practice the values of t are restricted by the laws of thermodynamics to under 2500 deg. F. The equation (5) simply asserts that if the second law of thermodynamics did not hold, and the heat from the outgoing clinker could be employed in heating the incoming air *above* 2500 deg. F., it would be possible to so preheat the furnace gases as to make them yield 54,723 B.t.u. per 1 lb. of coal burnt, and so produce 54,723 ÷ 918.6 = 56.6 lb. of clinker per 1 lb. of coal burnt. By putting in various other values of X we could obtain how much clinker can be produced under these circumstances by different weights of excess air. As these cases are impossible of realization under any natural conditions, they will not be further discussed here.

The subject, however, has a practical aspect, in that it tells us what *cannot* be done in kiln design, and what are possible measures for increasing output.

Consider, for example, the following very important point for kiln design:

As proved above, air entering a kiln and preheated to 2500 deg. F. by the issuing clinker cannot produce any more clinker than 15.732 lb., even under the most favorable circumstances. Otherwise we could increase indefinitely the output of a kiln by first supplying it with a little more air preheated to 2500 deg. F. by the clinker. This will produce by supposition a little more clinker, which could in its turn be utilized to preheat a little more air to 2500 deg. F., which again on introduction into the furnace would produce more clinker, and so on indefinitely. So that at first sight it might appear that it would be possible to increase *indefinitely* the amount of clinker per 1 lb. of coal consumed by supplying more and more hot air. This, we have proved above, is impossible. What does happen is that the increase of clinker with increased supply of hot air (heated by the outcoming clinker) tends to a limit which cannot be passed, and when the amount of air is increased beyond these limits, the clinker output begins to rapidly diminish. All devices, therefore, for increasing the efficiency of a kiln based on such false premises must fail.

Conclusions

The vital importance of the preceding thermodynamical proofs lies in this:

A high flame temperature is essential for increased kiln economy per 1 lb. of coal burnt.

In the modern rotary kiln the flame temperature is inordinately low at 2600 deg. F., and owing to this fact the rotary kiln is extremely inefficient. Unless the flame temperatures can be increased, *the limits set to kiln economy are narrow.*

Consequently, the attention of kiln designers should be directed towards supplying as much high-grade heat as possible into *the upper part of the kiln*—viz., the clinkering and decarbonating zones. Low-grade heat (such as is used in expelling water) is useless for increasing output of clinker, except in so far as it relieves the high-grade heat of certain work that it should never be allowed to perform, such as the expulsion of water from the slurry.

The same principle is evident in many familiar processes. For example, water boils at 212 deg. F., and if we wish to produce steam at any perceptible pressure, the B.t.u.'s must enter the water from gases heated *above* 212 deg. F. (100 deg. C.).

A million B.t.u.'s contained in material below 212 deg. F. are useless for raising steam at pressure greater than atmosphere. All this low-grade heat can do is to *preheat the water to 212 deg. F. and so take the burden off the higher-grade heat for this purpose.*

Similarly, in *lime-burning* the calcium carbonate could be heated for *years* to, say, 1000 deg. F. without producing a pound of lime. Unless the heat is supplied above 1481 deg. F. (805 deg. C.), lime will not be produced, and the measure of the amount of lime producible is measured by the number of B.t.u.'s available in the heating *gases before they cool to* 1481 *deg. F.* (805 deg. *C.*).

Practical Difficulties.—There are, however, very serious practical difficulties to contend with in increasing the flame temperature in the upper part of the kiln.

In the first place, the brickwork will only stand a fairly narrow limit of temperature, so that widely increasing the temperature will cause the brickwork to fail. Also the firing of coal dust with very hot air causes difficulties owing to the rapid combustion.

These difficulties can be got over in several ways:

(1) By increasing the refractory nature of the brick.

(2) By scientifically designing the shape of the clinkering zone so as to utilize the known principles of radiation and conduction.

(To be continued)

Standards Yearbook Just Published

THE APPROVAL of 46 new national industrial standards including projects in the field of mechanical, electrical, civil, mining, and chemical engineering, is announced in the American Standards Year Book for 1931 recently published by the American Standards Association.

In a foreword to the yearbook, which reviews developments in national and international standardization during the past 12 months, Charles F. Kettering, president of General Motors Research Corp., declares that the lack of co-ordinated functioning within and between industries is a major cause of business fluctuations and states that the national standardization movement is making a definite step toward the correction of this situation.

Proposes Better Employment Conditions

The Year Book proposes that industrial standardization on a nationwide scale be used by business and industrial leaders as one of the most important means of assuring continuous and in many cases guaranteed employment.

The list of new American standards includes (1) method of test for toughness of rock, (2) code of lighting (factories, mills, etc.), (3) methods of sampling stone, slag, gravel, sand and stone block for use as highway materials, (4) ball and roller bearings, (5) roller chains, sprockets and cutters, (6) safety code for installation of pulverized fuel systems, and many methods of test for petroleum products and lubricants.

Sieve Testing of Aggregates

A Survey of Screening Equipment and Methods of Charting and Comparing Results—With the Author's Original Methods, Criticisms of Test Sieves, and Recommendations

By Edmund Shaw
Contributing Editor, Rock Products

THE SIEVE TEST (or mechanical analysis) is the one all-important laboratory test of aggregates. From it we get the maximum size, the gradation and the fineness modulus. To a large extent the gradation so obtained determines the percentage of voids. And the value of the sieve test is just as great in the mining and chemical industries as it is in the rock products industry.

Hence the method of making the sieve test ought to be one which is accepted by everyone interested. The bituminous paver and the concrete worker should be able to understand one another and the mining engineer and the rock products engineer should discuss sieve tests in the same terms. We ought to have an international system of sieves and an internationally accepted method of making the sieve tests. As it is few of us know what is meant when we read of the "4900-mesh" sieve used for testing cement in Germany and still fewer know that a British 200-mesh sieve (0.063 mm.) is smaller than that used in the United States (0.074 mm.), and there is an older 200-mesh (about 0.0544 mm.) referred to in older books, that has smaller meshes still.

It is perhaps too much to hope for that we shall soon have an international sieve system and method of sieve analysis. But a standard method ought not to be impossible in the United States, where the industries represented have powerful national associations and all of them are represented in such specification-making bodies as the American Society for Testing Materials.

This society, of course, has adopted a standard method for testing aggregates. In fact it has adopted three methods and all three are in use, although only one has been standardized for concrete aggregates. The main source of confusion lies in the fact that there are three methods instead of one and that the industries will not use one to the exclusion of the others.

This causes no small difficulty to the reader of technical books and articles. In a single magazine article one may find screen analyses made with two systems of screens and three testing specifications. A good example is the paper by Gilbert and Kriege, "The Missing Link in Concrete Aggregate," Rock Products, June 21, 1930. The screen analysis shown in Fig. 2, p. 56 of that article is made with U. S. standard sieves, stated to be with square openings in the larger sizes. The analysis in the density and void curves in Fig. 4 were apparently made by Tyler standard sieves (since the Nos. 14, 28 and 48 were used), but this is not definitely stated. The sizes above No. 4 are therefore presumed to be square openings although there is nothing to show this to be the case. On page 58, Fig. 6, all the screens are stated to be "round sizes," which is manifestly a mistake as no round hole sieves are made in 10, 20, 30, 50 and 100-mesh sizes. Probably "round sizes" refers to the sizes from ¼-in. to 2-in. On page 61, the sizes from No. 4 to No. 100 are stated to be "square sizes" and sizes from 2½-in. to ¼-in. are stated to be "round sizes." On the same page in the first column are two screen analyses of a river sand, one using the series of Tyler standard screens used by Abrams for finding the fineness modulus and the other the screens of A. S. T. M. specification D 7-27. The "Gradation of Slag and Sand for Toledo Dock Work," on the same page, has both round holes and square holes and the combined aggregate sieve analysis uses both with no note to the reader. It is something of a tedious job to convert these to the same system of sieves so as to check this for fineness modulus and plot a smooth curve of the ordinary type.

Confusion could hardly go farther; and this is in an article on the gradation of aggregates.

The present writer does not want to criticize the authors of the article too strongly for it is only one of many instances of such a confusion. Most readers say: "What difference does it make whether Tyler screens or U. S. standard are used, or round holes or square holes?" It does make a difference. Anyone who studies and plots gradations given in books and magazine articles will find that the difference is sometimes enough to raise doubt as to what a writer is trying to prove. Then, too, it is impossible to make real comparisons between aggregates unless the sieve analyses are converted to the same system and plotted on the same graph.

To show this by an example: The writer was asked about the best gradation of sand to use with crushed slag graded from ¼-in. to 2-in. as coarse aggregates, and remembered some tests in a report of Committee C-9 of the A. S. T. M. The sieve analyses given in the report are shown on the opposite page.

To make these analyses two systems of sieves and three methods of testing were used. A and C laboratories used the sieves and method of A. S. T. M. Serial D. 7-27. Laboratory D used the sieves of A. S. T. M. C-41-24, U. S. standard, the standard method of testing concrete aggregates. Laboratories B and E presumably used the Tyler standard sieves recommended by Prof. Abrams for finding fineness modulus. One supposes this because the 28-mesh and 48-mesh used by them are not found in any other series. But assuming this to be so the Nos. 14, 28 and 48 mesh of the Tyler system are the equivalents of the Nos. 16, 30 and 50 mesh of the U. S. standard system to which the other sieves (again, presumably) belong. Nothing shows this definitely.

Looking at the sieve test figures, the only thing apparent is that the B sand is considerably coarser than any other. But such a feature as the parallelism of the A and D grading curves would not be noticed, although it would have been easily seen if the same set of sieves had been used by both

Editor's Note

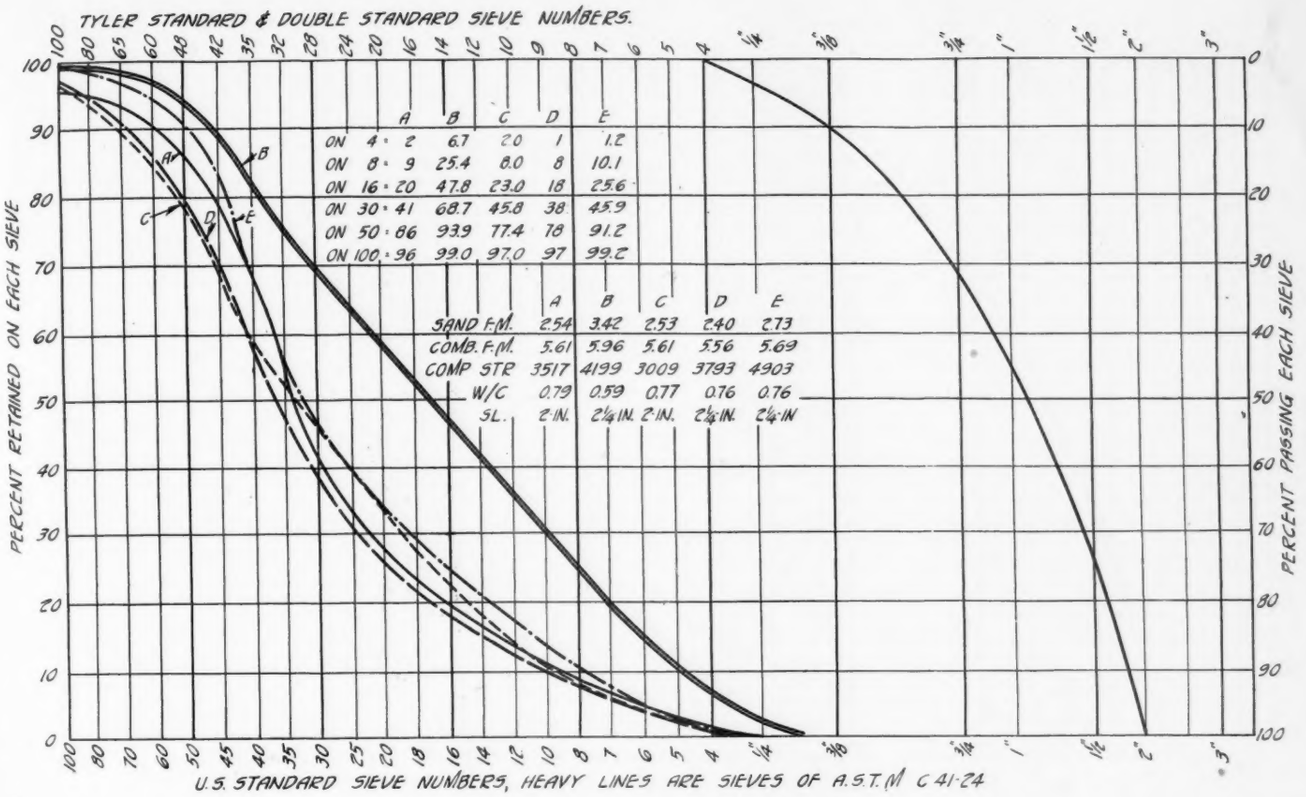
FEW EXCEPT testing engineers probably will realize or appreciate the tremendous amount of work, time and results of long experience that went into the preparation of this article.

Yet it covers so fundamental a subject to every producer of aggregates that we are sure all will profit from a reading and understanding of it.

It certainly is illogical for producers to be making and marketing materials which they themselves do not know better than anyone else.

Fortunately many progressive producers are graduating from this class. Sieve testing is now a regular feature at many up-to-date operations.

The knowledge gained from such regular tests and systematic records of them is invaluable not only in marketing the product but in planning and accomplishing any improvement in the product or in the efficiency and profitableness of the operation.—The Editor.


TYLER STANDARD & DOUBLE STANDARD SIEVE NUMBERS.
PERCENT RETAINED ON EACH SIEVE
PERCENT PASSING EACH SIEVE
U.S. STANDARD SIEVE NUMBERS, HEAVY LINES ARE SIEVES OF A.S.T.M C 41-24
A B C D E
ON 4 : 2 6.7 2.0 1 1.2
ON 8 : 9 25.4 8.0 8 10.1
ON 16 : 20 47.8 23.0 18 25.6
ON 30 : 41 68.7 45.8 38 45.9
ON 50 : 86 93.9 77.4 78 91.2
ON 100 : 96 99.0 97.0 97 99.2
A B C D E
SAND F.M. 2.54 3.42 2.53 2.40 2.73
COMB. F.M. 5.61 5.96 5.61 5.56 5.69
COMP STR 3517 4199 3009 3793 4903
W/C 0.79 0.59 0.77 0.76 0.76
SL. 2 IN. 2¼ IN. 2 IN. 2¼ IN. 2¼ IN

Grading of fine sands used in slag tests

laboratories. The C and A gradings can be compared from the figures, but the C and E sieve tests do not appear comparable as it is not shown that Nos. 28 and 30 sieves and Nos. 48 and 50 sieves are equivalents within the legal limit of tolerance. But when these are plotted on a graph containing all the sieves used, then the gradations may be compared, the fineness modulus figured and such tables as those given on the graph may be made.

The writer is indebted to R. C. Yeoman, engineer of the Construction Materials Co., Chicago, Ill., for the design and use of such a chart. It has more than an academic value. Mr. Yeoman keeps the sieve analyses of his company's products as records on a chart of this kind. The analyses are made with the Tyler system sieves used by Abrams to determine fineness modulus. But the other sieves are in their proper position so that the amount retained on, or passing, any sieve may be read off. It often happens that a customer wishes to know the amount passing a certain sieve not in the series used (20-mesh is a great favorite with the highway engineers of some states), and this can be found at once from the chart. Or if the customer wants a sand graded approximately the same as the gradation he has in one set of sieves, the gradation in the sieves used by the producer can be found at once by plotting. (See chart, page 61.)

George Adams Roalfe, Long Beach, Calif., has a similar and somewhat simpler chart of the kind that he worked out for Graham Bros. Other engineers have charts of the kind that they have devised. The writer has been over all that he could secure and has combined their advantages in one that is presented here. (Page 60.)

The necessity for doing this was shown by the mistakes that developed in checking up some of the charts in use. One error noted in two charts was that of giving different widths of opening to the Tyler No. 48 sieve and the U. S. standard No. 50 sieve, although the two are the same. Another had to do with equivalents of round and square sieves, a matter which will be gone into later, and still another example showed a confusion of logarithmic and direct plotting.

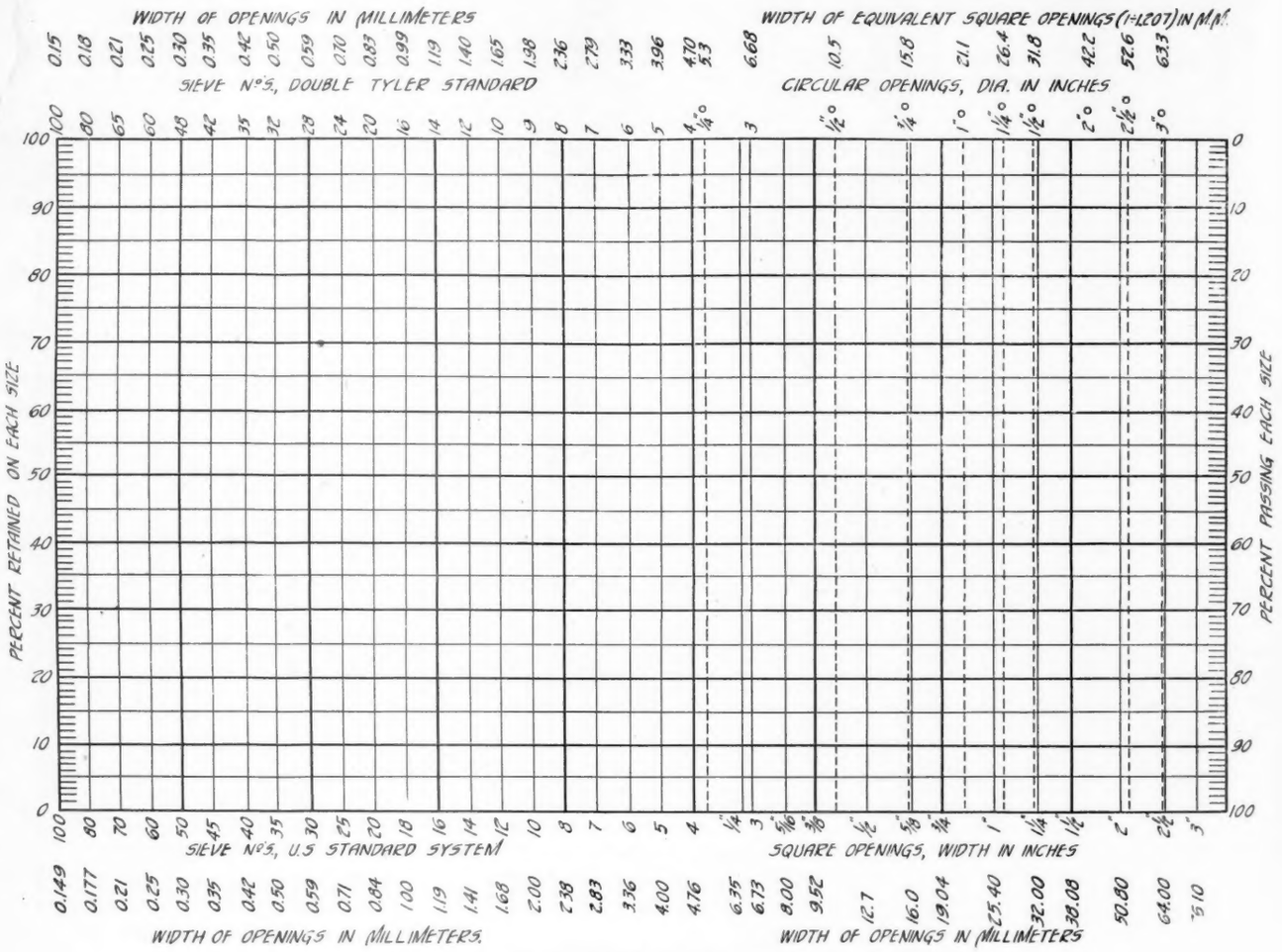
For this reason the writer has made a new chart, going back to first principles and plotting everything as the logarithm of the width of the opening in millimeters, and he has recorded this width on the chart so that there can be no chance of confusing one sieve, or opening, with another.

RESULTS OF TESTS ON SAND USED BY FIVE CO-OPERATING LABORATORIES

	Laboratory A	Laboratory B	Laboratory C	Laboratory D	Laboratory E
Total retained on No. 4 sieve	....	6.7	.....	1	1.2
Total retained on No. 8 sieve	....	25.4	.....	8	10.1
Total retained on No. 10 sieve	11	.....	10.8	....	.....
Total retained on No. 14 sieve	....	47.8	.....	....	25.6
Total retained on No. 16 sieve	....	.....	.....	18	.....
Total retained on No. 20 sieve	28	.....	32.8	....	.....
Total retained on No. 28 sieve	....	68.7	.....	....	45.9
Total retained on No. 30 sieve	41	.....	45.8	38	.....
Total retained on No. 40 sieve	68	.....	58.2	....	.....
Total retained on No. 48 sieve	....	93.9	.....	....	91.2
Total retained on No. 50 sieve	86	.....	77.4	78	.....
Total retained on No. 60 sieve	....	.....	86.2	....	.....
Total retained on No. 80 sieve	95	.....	93.0	....	.....
Total retained on No. 100 sieve	96	99.0	97.0	97	99.2
Total retained on No. 200 sieve	97	.....	.....	99	.....
Fineness modulus	....	3.42	.....	....	2.73
Clay and silt, per cent	2.9	0.8	1.8	....	0.4
Colorimetric test	Satisfactory	No. 1	No. 1		No. 1

Sieves and Methods for Sieve Analysis

Specification Serial C 41-24, American Society for Testing Materials, is the society's standard method for testing concrete aggregate. It specifies the sample to be from 100 g. to 500 g. if of fine aggregate, and at least 3000 g. times the opening of the largest sieve in inches if of coarse aggregate. (It is the writer's opinion that this should be larger where 2¼-in. and 3-in. pieces are present.) If more than 15% of a fine aggregate sample is coarser than No. 4 size, or more than 15% of a coarse aggregate sample is finer than a No. 4 sieve, separate analysis of the portions coarser and


WIDTH OF OPENINGS IN MILLIMETERS
WIDTH OF EQUIVALENT SQUARE OPENINGS (1-1.207) IN MM.
SIEVE NOS., DOUBLE TYLER STANDARD
CIRCULAR OPENINGS, DIA. IN INCHES
PERCENT RETAINED ON EACH SIZE
PERCENT PASSING EACH SIZE
SIEVE NOS., U.S STANDARD SYSTEM
SQUARE OPENINGS, WIDTH IN INCHES
WIDTH OF OPENINGS IN MILLIMETERS.
WIDTH OF OPENINGS IN MILLIMETERS

Multiple sieve scale logorithmic graph designed by the writer

finer than this sieve should be reported. Percentages *passing* each size are to be reported and they are to be reported to the nearest whole number.

The sieves specified are from the sieves required by A. S. T. M. specification Serial E-11, which are those generally known as the U. S. standard sieves. They are:

Sieve	Opening in mm.	Opening in in.
No. 100	0.149	0.0059
No. 50	0.297	0.0059
No. 30	0.59	0.0232
No. 16	1.19	0.0469
No. 8	2.38	0.0937
No. 4	4.76	0.187
⅜-in.	9.5	0.375
¾-in.	19.0	0.75
1 -in.	25.4	1.00
1½-in.	38.0	1.50
2 -in.	50.8	2.00
3 -in.	76.0	3.00

Tolerances of 6% are permitted in the openings of Nos. 50 and 100, 5% on No. 30 and 3% on all the others. This specification seems to the writer to be so complete and so logical that he sees no reason why any other should be preferred.

The sieves of this series finer than ⅜-in. (Nos. 4, 8, 16, 50 and 100) are recommended in A. S. T. M. specification C 35-28 T and also in A. C. I. specification, E-5 A-29 T for testing fine aggregate. It would seem logical and sufficient to have the finer sieves of a series used for testing the finer part of an aggregate which is to be tested by the whole series. But there are many laboratories that prefer to use another series of sieves altogether for testing *fine* aggregate. This is the series given in A. S. T. M. D. 7-27, although the A. S. T. M. Book of Standards (in at least one edition) says that this specification is to be used for materials other than concrete aggregate. The sieves for this D. 7-27 specification are:

Sieve	Opening in mm.	Opening in in.
No. 10	2.00	0.0787
No. 20	0.84	0.0331
No. 30	0.59	0.0232
No. 40	0.42	0.0165
No. 50	0.297	0.0117
No. 80	0.177	0.0070
No. 100	0.149	0.0059
No. 200	0.074	0.0029

This was adopted in 1917. It is easy to see how the force of long custom and the fact that many records have been made with it keeps it in use.

These two methods of making the sieve analysis of fine aggregates may be considered official. But there is a third method almost as much used because the laboratories of some large companies hold to it. This method is that given by Duff A. Abrams, in Bulletin No. 1 of the Lewis Institute Structural Materials Laboratory for obtaining the fineness modulus of aggregates. It employs the following screens of the Tyler standard:

No.	Opening mm.	Opening in.	Nearest U. S. std.	Opening mm.
No. 100	0.150	0.0058	No. 100	0.149
No. 48	0.300	0.0116	No. 50	0.300
No. 28	0.590	0.023	No. 30	0.590
No. 14	1.17	0.046	No. 16	0.119
No. 8	2.30	0.093	No. 8	0.094
No. 4	4.70	0.185	No. 4	0.476
⅜-in. ¾-in. 1½-in. 3-in.	The same in both series. All square mesh openings.			

The Tyler standard is older than the U. S. standard. The original Tyler standard was based on the square root of 2, (1.414), hence each sieve opening is made 1.414 times the width of the openings of the preceding sieve of the series. As this did not give enough sieves for some purposes, the double-Tyler standard was brought out. This was based on the fourth root of 2, (1.189), each sieve opening being 1.189 times that of the preceding sieve.

The U. S. standard is also based on the

CONSTRUCTION MATERIALS CORPORATION

ENGINEERING DEPARTMENT

REPORT OF SAND AND AGGREGATE TESTS

Test No. .... 19.....

For .....

Address .....

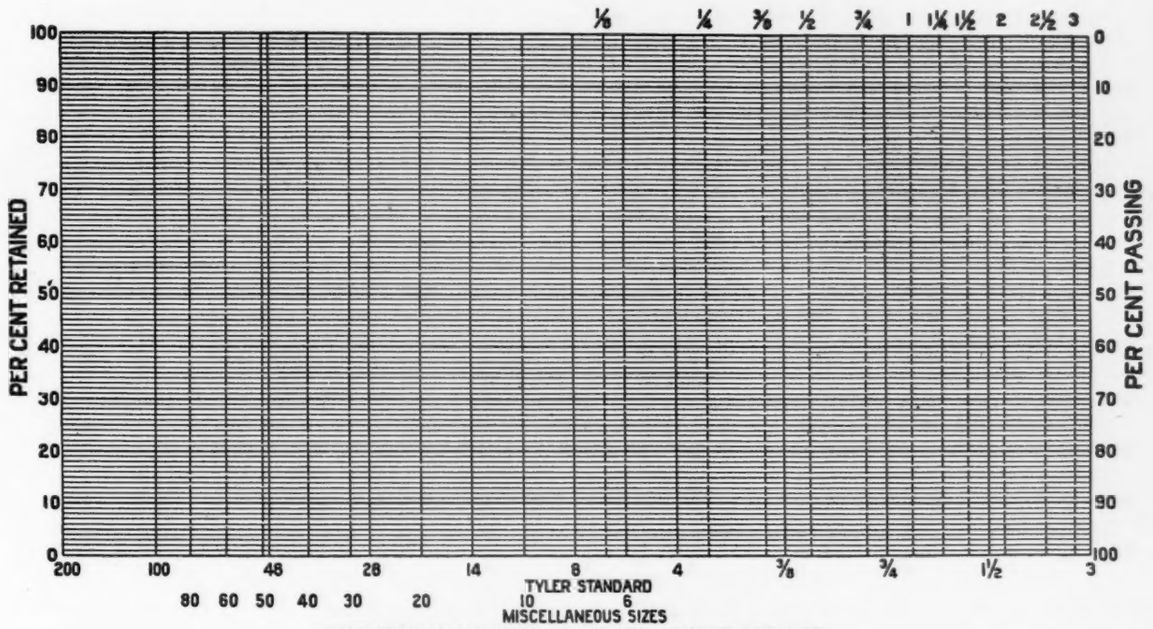
Name of Material ..... Identification .....

Submitted by ..... Sampled by ..... on ..... 19.....

Sampled from ..... Quantity represented .....

Source of Material ..... To be used .....

COMMERCIAL NUMBER OF SCREENS, ROUND OPENING



COMMERCIAL NUMBER OF SIEVES, SQUARE OPENING

Sieve Number	Wt. Retained	Total Per Cent. Retained		
		on Each Sieve	Cumulative	

Special Tests	
Silt, Clay and Dust	
Organic Impurities	

Remarks:

Respectfully submitted,

_____

_____ 19.....

Approved by _____

Chart used by one producer for sieve analysis

fourth root of 2, so the sieves of the U. S. standard and double-Tyler systems should be identical. That they are not is due to the thickness of the wires used. The No. 28 Tyler and the No. 30 U. S. standard both have openings 0.59 mm. wide, but one has 28 meshes to the inch instead of 30 because it is made of a little coarser wire.

When the U. S. standard was brought out some mining engineers thought it deplorable that the Tyler standard had not been adopted by the U. S. Bureau of Standards. But it seems to the writer that the U. S. standard scale is so much of an improvement that it was worth the trouble of adopting it. A most important feature of the U. S. standard scale is that it has sieves with openings in even millimeters, which the Tyler scale does not have. There would be no difficulty in having this scale adopted internationally as all foreign scales are based on the millimeter, and if the ratio of the fourth root of 2 were adopted the screens would be bound to be the same. Then the writer never did like the Tyler system of numbering with such numbers as 28, 48 and 65. The U. S. standard numbering, progressing by tens, then fives, then twos and then by units seems to him to be much more orderly.

In the table just given the two columns at the right give the U. S. standard equivalents of the Tyler sieves and the width of openings. The difference, it may be noted, is less than the plus or minus 3% tolerance permitted by specifications C 41-24 and E-11. Hence the screens are as much equivalents as two screens of the same make and standard would be after a little use.

All the charts for converting from one sieve scale to another which the writer has seen have these three series of sieves, C 41-24, D 7-27 and the Tyler sieves recommended by Prof. Abrams. The chart which the writer has worked out varies from them only in that it shows more sieves, *all* the sieves of the U. S. standard and Tyler standard scales, and it also gives the width of each opening in millimeters. This information is often needed, as for finding mean effective size and coefficient of uniformity, and it saves any confusion resulting from a mistaken impression as to what a sieve number really stands for. Each regular space is the logarithm* of 1.189 (the fourth root of 2); each line represents a sieve. The full lines are sieves with square openings; the heavy full lines are the sieves of C 41-24, and the dotted lines are sieves with round openings.

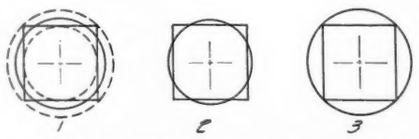
These spaces are divided into fourths, each fourth being almost exactly 1.19 on the scale. Each line from 8.00 mm., which is the opening of No. 2½ sieve down as far as one cares to go on the scale, represents a sieve of the U. S. series. The scale here does not go below 0.149 mm., which is No. 100. The numbers of sieves and all the openings are given in the illustration. They may also be found in screen manufacturers' catalogs and various government bulletins and A. S. T. M. publications.

The sieves that do not fall on the lines of this diagram are placed by setting off the width of the opening in mm. from the slide rule. Thus a ¼-in. square sieve has a 6.35 mm. opening, a 1-in. sieve a 25.4 mm. opening, and so on. The vertical divisions representing percentages were taken from a piece of cross-section paper. The writer finds it easier to set off the distances from a slide rule or logarithmic scale than to use logarithmic paper, with its many lines, in making a plot of this kind.

"Percentages retained on" are shown on one side, "percentages passing" on the other. The writer has a strong preference for reporting percentages retained on. It not only has the force of many years of custom behind it, but it is the determination actually made. In making the sieve analysis one empties the sieves on the scale and weighs the contents, the percentage retained on. It seems silly to subtract this actual determination from 100 and report it that way. But if everyone else will do the same the writer will cheerfully change to the other system for the sake of uniformity.

Round Holes and Square Holes

Serial C 41-24 calls for square-hole sieves straight through from 100-mesh to 3-in. width openings. D 7-27 calls for square-hole sieves from 10-mesh to 100-mesh. But serial D 18-16 calls for round holes (circular openings) for ¼-in. and larger sieves, and the use of these probably causes more trouble in understanding sieve analyses than the use of different sets of fine aggregate sieves. It occasionally has happened that producers receiving an order with a specification calling for square-hole sieve sizes of coarse aggregate have attempted honestly to fill it with material graded on round-hole sieves. The difference does not look much, but in reality it is extremely important. A gravel producer might be able to fill an order calling for "not more than 75% passing a 1-in. screen and not more than 25% passing a ¾-in. screen" easily with round-hole sieves, and find it quite impossible to fill the same order with square-hole sieves, without wasting much of his product. If only 25% passed the round-hole, ¾-in. sieve, about 35% would pass the square-hole; and if only 75% passed the round-hole, 1-in., about 85% would pass the square-hole 1-in.



The circle (1) half way between the inscribed and circumscribed circle is the nearest equivalent to the square. The circle of equal area (2) is too small and the circumscribed circle (3) is too large

Some producers who use round-hole screens in the plant for making a product feel that the product should be tested by round-hole sieves as no square-hole can be the exact equivalent of a round-hole in screening effect. This argument was raised some time ago by coal producers who wanted mining engineers to test their products by round-hole screens.

If the argument ever had any effect it has not so much now. Round holes are used in rotary screens as they always have been, but an increasing number of plants use vibrating and shaking screens with square-mesh wire cloth, and rectangular slotted plates are much used on both rotating and vibrating screens. The only valid argument that the writer has heard for a round-hole testing sieve is that a plate punched with round holes makes a better sieve to work with and it is less liable to accident than a sieve with square wire meshes. It is true that one sometimes sees sieves with coarse meshes in which the wires have been bent enough to distort the meshes. Of course it would be quite feasible to use a square-hole punched sieve to obviate this.

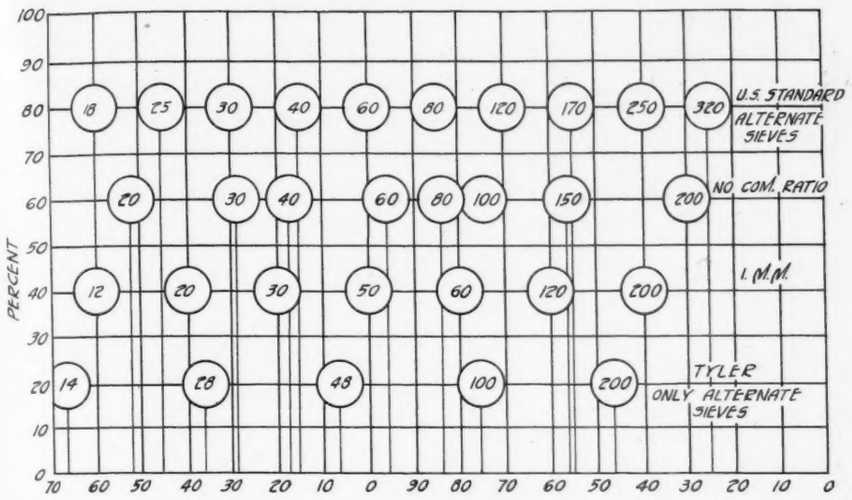
However, it is futile to argue against the use of round-hole sieves in an article like this because their use is too firmly fixed. What is wanted is a set of equivalents for round and square holes.

The writer has met engineers who were firmly convinced that round-hole and square-hole screens of the same area were equivalents. One has only to draw a 2-in. square and a 2¼-in. circle, which have practically the same areas (4 sq. in. and 3.976 sq. in.), to see that a flat piece which would not pass the circle will easily pass through the square on the diagonal. Others have thought that a circle circumscribed around the square was an equivalent. But a "fat" or cylindrical piece will pass this circle and not pass the square.

At present engineers who have studied the question seem to be agreed that a circle which has a diameter 1.207 (or 1.2) times the side of the square is the equivalent of the square. This is a circle half-way between the circumscribed and the inscribed circle of the square. Joseph A. Kitts in an article, "Screen Sizes for Concrete Aggregates," Rock Products, June 8, 1929, calls this 1.207 ratio the "average diameter" of the square. He gives the following table of the square coarse sieves and what he considers the round-hole equivalents. The writer has added the dimensions in millimeters, in parentheses:

Standard screen side of square-hole		Equivalent round-hole diameter	
in.	mm.	in.	mm.
3	(76.1)	3.6	(91.5)
2	(50.8)	2.4	(61.0)
1.5	(38.1)	1.8	(45.7)
1	(25.4)	1.2	(30.5)
0.75	(19.0)	0.9	(22.8)
0.375	(9.5)	0.45	(11.4)

*The writer found that an easy way to construct such a logarithmic scale is to set off the points 1, 2, 4, 6, 8, 16, 32, 64 from the A-scale of a 10-in. slide rule. Then taking the 100 of the scale as 1 to set off 0.50, 0.25, 0.125, on the other side. All these spaces are the same width, however.



Randall's multiple-scale plot, used for converting to any of the four sieve scales used in the mining industry

If we accept this ratio of 1 to 1.207 for square and round-holes, then the square-hole equivalent of a round-hole will have a width of $1 \div 1.207$ or 0.8283, which is practically 83% of the diameter of its round-hole equivalent.

Based on this, the round-hole testing sieves called for by A. S. T. M. Serial D 18-16 and their square-hole equivalents are given in the following table:

Sieves of Serial D-18-16 (Dia. of round-hole)		Equivalent square-holes (Side of square)	
in.	mm.	in.	mm.
3½	88.9	2.90	73.8
3	76.1	2.49	63.3
2½	63.5	2.08	52.6
2	50.8	1.66	42.2
1½	38.1	1.25	31.8
1¼	31.8	1.04	26.4
1	25.4	0.83	21.1
¾	19.0	0.622	15.8
½	12.7	0.415	10.5
¼	6.4	0.208	5.3

The widths in millimeters given in the right hand columns have been plotted as the square-hole equivalents of the round-hole screens in the chart.

Conversion by a chart of this kind cannot be exact, but it is exact enough for practical purposes. The writer has tested it in many ways and with different kinds of gradation. The conversion is fairly close on ordinary smooth gradations if there are screens enough and they are as equally spaced as they are in most systems. "Gap" gradations are not so readily converted as the line found by conversion has a way of skipping over the gaps, if it is not very carefully drawn, crediting the material with a better gradation than it really has.

With gradations of the ordinary type the differences found by converting and reconvertising are of the order of 1% or 2%. An example is shown at bottom of page.

To make a satisfactory conversion like the one given, the points of the sieve analysis originally plotted must be connected by a *smooth curve*. Any sieve analysis of a natural product whether it be a crusher discharge, sand swept by the wind into a dune, or sand and gravel sorted by a flowing stream, will plot as a smooth curve, and the more screens that are used the smoother the curve will be. Of course artificial mixtures may have any gradation. A gradation that plots as a broken line or as a curve with humps and hollows may be confidently asserted to be that of an artificial mixture, provided that the sieves used are known to be correctly marked. The writer has known of a sieve, that had been wrongly labeled at the factory, being detected by its plot making a "hump" in an otherwise smooth curve.

In drawing this curve one may be guided by the knowledge that the curve of many natural sands is like an elongated S, which lies at a flat angle if the sand is well graded, and at a steeper angle as the gradation becomes more uniform. This may be noted in the curves given here. A coarse gradation tends more to be a straight line.

Exceptions to this are found in gradations which do not plot as a reversed curve or with only a slight reversed portion at the end, like the B curve in the curves of the five sands. Such curves may be either convex or concave. The fine sand overflows obtained in washing sand usually plot as a decidedly concave curve, and the coarse sand made by water classification, with all fines washed out, often plots as a convex curve. But such curves are easy to recognize and draw. In drawing any curve of a gradation it should be remembered that: the curve is always ascending; it is always smooth, and its curvature is normally greatest in the center and least at the ends.

EXAMPLE OF CONVERTING AND RECONVERTING

Actual sieve Analysis		Converted by Chart to		Reconverted to		Difference or
On 10	9%	On 4	1%	On 10	9%	.....
On 20	34%	On 8	7%	On 20	35%	+1%
On 30	63%	On 16	19%	On 30	63%	.....
On 40	79%	On 30	63%	On 40	78%	−1%
On 50	86%	On 50	86%	On 50	86%	.....
On 80	96%	On 100	97%	On 80	95%	+1%
On 100	97%			On 100	97%	.....

Correctness of Conversion

The writer was given a printed series of sand gradations with the fineness modulus of each sand, but the sieve analysis was made with different sieves than those which are used to find the fineness modulus. This gave an excellent opportunity to check the method of converting from one sieve analysis to another by plotting. In every case tested there was a close correspondence between the fineness modulus given and that found from the sieve analysis given by conversion, the exceptions being cases in which it could be shown that the fineness modulus must have been determined on another sample altogether.

Three examples follow. In the second, the difference in fineness moduli was 0.05, the greatest difference found.

No. 1 Original		Converted to	
On 10	27%	On 4	8%
On 20	58%	On 8	24%
On 30	81%	On 16	37%
On 50	92%	On 30	81%
On 100	97%	On 50	92%
		On 100	97%

Fineness modulus given 3.39; calculated from above conversion, 3.39.

No. 2 Original		Converted to	
On 10	21%	On 4	7%
On 20	47%	On 8	17%
On 30	73%	On 16	31%
On 50	91%	On 30	73%
On 100	96%	On 50	91%
		On 100	96%

Fineness modulus given, 3.10; calculated from above conversion, 3.15.

No. 3 Original		Converted to	
On 10	13%	On 4	4%
On 20	45%	On 8	10%
On 30	66%	On 16	23%
On 50	84%	On 30	66%
On 100	93%	On 50	84%
		On 100	93%

Fineness modulus given, 2.78; calculated from above conversion, 2.80.

The matter of drawing a smooth curve brings up the question of how many sieves should be used in making a sieve analysis. The series, Nos. 4, 8, 16, 30, 50, and 100, recommended in C 41-24, probably came into use because they (or rather their Tyler standard equivalents) were specified by Abrams for finding the fineness modulus of sands. They are usually good enough for the buying and selling of aggregates, but they are not enough when the work of screens and classifiers has to be tested with a view to improvement. For a really close study of a separating device the full U. S. standard series, or the double Tyler series

should be used. Where a specification calls for a sieve that is not in the regular C 41-24 series, it is a simple matter to put it in, making the series, say, 4, 8, 16, 20, 30, 50, and 100. If the ordinary logarithmic plot with equal spaces is used the percentage on 20-mesh can be plotted on a line half-way between the 16-mesh and the 30-mesh lines.

Other Industries Have Confusion of Screen Systems

The rock products industry is not alone in having to cope with a confusion of screen systems and methods. The mining industry has three or four systems which are regularly in use, and there are two or three others which are advocated by distinguished engineers. A conversion chart showing the three sieve scales regularly in use and one sometimes used is given here. It is redrawn from Prof. Taggert's Handbook on Ore Dressing and is called Randall's multiple scale plot. Inspection shows it to be incorrect. The Tyler sieves should be set to touch the lines at the right for all the Tyler sieves shown are equivalent to the missing sieves of the U. S. standard series on the top line. The I. M. M. series is one that was adopted by the British Institute of Mining and Metallurgy. It is not a good scale for it has no constant ratio between screen openings and no base. It was adopted because the wires and openings were those that it was thought would insure perfect locking in crimping, so that the meshes would not become distorted. Each sieve opening in inches is 1 divided by twice the sieve number. A No. 16 sieve would have an opening 1/32-in. wide ($1 \div 2 \times 16$). Of the series which have been proposed the most attractive is the Hoover system, which is based on the cube root of 2 (1.26). It contains fewer sieves than the U. S. scale (23.28) and more than the standard Tyler scale (23:15), and it has regular sieves of 1-in., ½-in., ¼-in., etc., as well as a series in even millimeters, 0.25, 0.5, 1, 2, 4, 8 mm., etc. But in spite of all these advantages it is to be hoped that it will not be adopted by any specification-making body as we have all the confusion of scales and methods now that we can stand.

What the writer would like is that all producing companies and laboratories testing aggregates should keep records on a chart like that shown so that conversions can be read off without any trouble. He believes that the whole country should settle on A. S. T. M. Serial C 41-24 for testing aggregates and reporting according to this. It would cause some confusion in looking up old records, but records lose their value very quickly these days and published articles are obsolete in a year or two. The mining industry went through just as violent a change about 20 years ago when the Tyler system was adopted by the American Institute of Mining Engineers. It survived and no one would have gone back to the old haphazard system after a few months experience with the new system.

Cement Veteran Retires

ANNOUNCEMENT has just been made by the Universal Atlas Cement Co. of the retirement of Edward D. Boyer as technical service manager of the New York office. Mr. Boyer's business career has been coincident with the growth of the cement industry in America, and his memoirs, should he be inclined to write any such in this period of leisure, would constitute a delightful and illuminating record.

Only a few straggling American cement mills were daring to compete with the product from Europe, and modern large-

Edward D. Boyer

scale production of huge rotary kilns for low-price construction markets was undreamed of back in 1888, the year of Mr. Boyer's entry into the cement business as superintendent of a mill at Cementon, Penn. A native of Catasauqua, Penn., in the now famous cement-producing Lehigh Valley, he had specialized in chemistry at Muhlenberg College, Allentown, and had graduated from the Philadelphia College of Pharmacy as president of the 1877 class of more than 400 members. The cement field had attracted his attention at an early age through the establishment of the first American plant at Coplay, a few miles above his home and college communities, by David O. Saylor in 1872. The first American concrete pavement was to be laid 20 years later at Bellefontaine, Ohio, where it is still in service; and by 1897 American cement mills achieved a production exceeding European imports.

Displacement of the old dump kilns by the new rotary kilns forced the company employing Mr. Boyer to dissolve, and sent him instead to Elizabeth, Penn., in 1900, to build a rotary kiln plant. It was never operated, however, because the patented process of manufacture proved unsuccessful. He then joined the Atlas organization in 1902 as assistant to the general superintendent of the Northampton, Penn., plant, taking up the duties of technical department manager in New York in 1914.

During the world war Mr. Boyer was chairman of the Portland Cement Association's committee on concrete ship construction, assisting in the construction of several concrete vessels for the United States shipping board. He is 73 years of age, lives at 55 East Tenth Street, New York, and is a member of the Engineers', New York City, and Westchester Hills Golf clubs. He is a director and former president of the American Concrete Institute and a past director of the American Society for Testing Materials, and has been for many years a member of the Portland Cement Association's technical problems committee. A feature of recent conventions of the American Society for Testing Materials has been Mr. Boyer's annual presentation of the convention golf and tennis trophies.

E. K. Borchard, technical service engineer, also of New York, who joined the Atlas organization in 1917, takes Mr. Boyer's place. Mr. Borchard represented the shipping board during construction of the concrete ship *Faith* at San Francisco in 1918 and also aided in building other concrete ships and barges. From 1911 to 1916, with headquarters in Philadelphia, he directed promotional work for the Association of American Portland Cement Manufacturers, now the Portland Cement Association.

Take Barge Over Dam

EMPLOYES OF THE Consumers Sand Co., Topeka, Kan., recently moved a 20-ton sand boat from Topeka to Holliday, Kan., near Kansas City, where the company is establishing a new sand plant. A crew of five took the large boat down the Kaw River to Holliday.

The boat was rigged up like an old stern-wheeler, with a paddle wheel. The wheel was engine driven and gave the boat enough power to forge down the river. The pilot stood on the cabin and picked out the deeper parts of the channel, as the boat takes about 30 in. of water. An outboard motorboat preceded the larger boat to pick the channel.

The cabin contained beds, a stove, table, cupboard and enough provisions for five men.

The boat is 65 ft. long and 24 ft. wide. Its trip down the Kaw marks the first time in 40 years, according to Harold Richardson, local manager, that such a large boat had been taken down the river. The boat reached Lawrence April 13 and was lifted across the dam there.

There is a large spillway at one side of the dam where the water flows across at about 6-in. depth. A Lawrence house-moving concern lifted the boat over the spillway.

F. A. Laughead, Topeka, is president of the company.—*Topeka* (Kans.) *Capital.*

Preparation and Laboratory Control of Foundry Sands*

By J. D. Burlie
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THIS is the paper which won the Charles Ellet Award of the junior members of the Western Society of Engineers last year. The author had the opportunity to make the studies described here in a foundry adequately equipped with the necessary apparatus and producing a varied product. This paper does not attempt to cover the operations in foundries producing heavy castings.—The Editor.

THE ART of casting metals dates back beyond the period of written history. Until fifty years ago the foundryman, due to a lack of available technical information, was obliged to pursue his task like the artisan of old. Times have changed, and the castings must compete with other construction materials on both a cost and quality basis. The advent of the engineer in the foundry industry is contributing largely to the establishment of positive manufacturing control. There are four major factors in foundry practice, namely, Management, Equipment, Metal, and Sand, each of which must be held within fixed limits of efficiency in order to assure the continued production of quality castings. Each factor is a study in itself.

It is the purpose of this paper to outline the general characteristics, source, preparation, requirements, and method of control of foundry sands.

General Characteristics of Foundry Sand

There are four main branches of the foundry industry, each having requirements for sand which differ in detail, but all of which must have the same essential properties. These branches, Steel, Malleable, Gray Iron, and Non-ferrous follow in line directly with the temperature of molten metal used in each.

The steel industry must have a highly refractory, coarse, open sand, while malleable and gray iron foundries require refractory and open sands of a finer grain size in order to produce castings of a smooth surface finish. Refractoriness and openness, coupled with high strength and fine grain size, are essential for casting brass and bronze. Aluminum requires fine grained open sand, but not necessarily having a high refractory quality. Baked sand cores using artificial bonding compounds will be considered in a separate class.

The fusion temperatures of natural molding sands range from 1620 to 3000 deg. F., and the pouring temperatures of the various metals are as follows:

		Degrees Fahrenheit		
Metal	Mixture pct.	Gen'l work	Light work	Heavy work
Aluminum	Alloy	1300	.....	.....
Red brass	85-5-5-5	2000	2150	2000
Red brass	82-4-6-8	2000	2100	1950
Yellow bronze	80-20	2000	2100	1950
Phosphor bronze	80-10-10	1950	2000	1900
Gun metal	88-10-2	2050	2100	2000
White iron	.....	2570	.....	.....
Converter steel	.....	2800	.....	.....
Gray iron	.....	2420	.....	.....
Basic elec. steel	.....	2820	.....	.....
Acid elec. steel	.....	2800	.....	.....

Source of Sands

The types of sand and their characteristics will first be considered. There are two main classifications of sands, namely, sands containing little or no natural bonding material, and sands containing natural bonding materials. The first group is used essentially in the production of synthetic molding sands and cores, and the latter as a molding sand.

Sands Containing Little or No Binding Materials

Sands are being used for core purposes from a great variety of natural deposits, as it is customary to use whatever sands are available locally.

Sands are classified according to their origin geologically, such as glacial drift sands, river sands, sea sands, lake sands, dune sands and sandstone deposits.

(1) *Glacial Drift Sands* (often called bank sands) are deposits found in the glacial drift of northern United States and Canada. They were deposited by the rivers and streams as a result of the melting of the receding glaciers of the last geological period. They are essentially river deposits and are composed of grains of varying size and shape. They usually contain considerable quantities of fines (fine sand particles), lime and clay. The varying grain size and shape greatly reduce the venting property of the sand. This type of sand has good green bond strength and is often used for this property alone. A typical chemical analysis of a Wisconsin bank sand is as follows:

Silica (SiO_2)	90.42%
Iron oxide and alumina (Fe_2O_3 + Al_2O_3)	5.84%
Lime and magnesia ($CaO + MgO$)	3.59%
Volatile matter	0.15%

(2) *Sea Sands* are found along sea shores, and are quite free from fines, lime, and clay, and the grains are well rounded. These sands contain small quantities of alkalies (salts) which are moisture absorbing. A typical chemical analysis is as follows:

Silica (SiO_2)	98.00%
Loss on ignition	0.50%
Acid solubles ($K_2O + Na_2O$)	0.80%
Lime (CaO)	0.40%
Chlorides	0.30%

(3) *Lake Sands* are somewhat similar to sea sands except that they usually contain considerably more lime, but no alkalies. These sands are usually those which have been pumped from lake bottoms, but also include those found along lake shores. The sands pumped from the lake bottoms contain considerable quantities of lime (as shells) and organic matter and are irregular as to fineness. A typical analysis of a lake sand is as follows:

CHEMICAL ANALYSIS

Silica (SiO_2)	80.45%
Iron oxide and alumina (Fe_2O_3 + Al_2O_3)	9.80%
Lime (CaO)	5.20%
Magnesia (MgO)	0.40%
Loss on ignition	4.15%

SCREEN ANALYSIS

Held on a 20-mesh screen	None
Held on a 40-mesh screen	1.00%
Held on a 70-mesh screen	37.25%
Held on a 100-mesh screen	34.05%
Held on a 140-mesh screen	20.05%
Held on a 200-mesh screen	7.35%

(4) *Dune Sands* are a wind-blown lake and sea sand. The wind action re-sorts the sands, removing the fines and aiding the weathering action in removing the lime. These deposits are composed of rounded grains of uniform size and contain very small amounts of undesirable impurities. An analysis will show from 95 to 99% pure silica. These sands are considered best for core purposes and are used in synthetic molding sands. A typical analysis is as follows:

CHEMICAL ANALYSIS

Silica (SiO_2)	95.65%
Iron oxide (FeO)	0.42%
Alumina (Al_2O_3)	1.76%
Lime (CaO)	0.65%
Magnesia (MgO)	0.58%
Sulphuric anhydride (SO_3)	0.38%
Organic matter and volatiles	0.56%

SCREEN ANALYSIS

Held on a 10-mesh screen	None
Held on a 20-mesh screen	0.52%
Held on a 40-mesh screen	5.37%
Held on a 70-mesh screen	80.70%
Held on a 100-mesh screen	11.72%
Held on a 140-mesh screen	1.11%

*Reprinted from "Journal of the Western Society of Engineers."

Sands Containing Natural Bonding Materials

Sands containing natural clay bonding materials are found in every state in the Union and in most foreign countries. They have been formed as sand deposits from streams, lakes, oceans, or glacial drifts and by the grinding action of the earth's crust upon solid rock. The deposit of clay has been formed by deposition from surface and ground waters over long periods of time. The sand itself is of a silica base, while the clays may be of a wide variety of compositions. J. F. McMahon of the Department of Mines, Ottawa, Canada, conducted a series of tests to evaluate the refractory properties of molding sands. The sands under test showed the following variations in analysis:

Name	Formula	Per cent.
Silicon dioxide	SiO_2	95.86 to 46.67
Aluminum oxide	Al_2O_3	24.81 to 2.03
Ferric oxide	Fe_2O_3	5.47 to 0.13
Ferrous oxide	FeO	0.56 to 0.15
Magnesium oxide	MgO	1.78 to 0.16
Calcium oxide	CaO	4.55 to 0.14
Sodium oxide	Na_2O	1.50 to 0.06
Potassium oxide	K_2O	5.45 — 0.50
Ignition loss		12.29 — 0.47
Water	H_2O	3.18 — 0.28
Titanium oxide	TiO_2	0.97 — 0.06
Carbon dioxide	CO_2	3.52 — None
Zirconium oxide	ZrO_3	Trace to none
Phosphorous pentoxide	P_2O_5	0.15 to none
Sulphuric anhydride	SO_3	0.42 to none
Chlorine	Cl_2	0.03 to none
Manganese trioxide	MnO_3	0.06 to trace
Barium oxide	BaO	0.04 to none

The clays containing principally alumina (Al_2O_3) and ferric oxide (Fe_2O_3) are found in the combined state in various combinations, so that an accurate classification of each mineral is practically impossible. The most desirable material as a plastic binder is kaolin (Al_2O_3, $2SiO_2$, $2H_2O$), but alumina may also occur as feldspar or orthoclase (K_2O, Al_2O_3, $6SiO_2$), or muscovite (H_2 (K, Na), Al_3, Si_2O_{12}). Ferrous oxide (FeO), magnesium oxide (MgO) and calcium oxide (CaO) are refractory in themselves, but flux readily with alumina (Al_2O_3) or silica (SiO_2) and are therefore undesirable. The alkalies, potassium and sodium oxides (K_2O and Na_2O), are not refractory and are active fluxes.

On a test run of a number of American sands, the following analyses were reported, (See accompanying table.)

Of the many well known sands in the United States, those of New York, Ohio and Indiana are the most popular. The Hudson river valley sands from and near Albany enjoy an international reputation for openness, strength, uniform grain size and durability. Ohio sands are generally uniform and strong, being found along the Ohio river in the southern part of the state. Indiana has deposits of every known grade of foundry sand, the coarser sands being found in the northern lake region and the finer in the Wabash and Ohio river valleys. Windsor Lock sand from Connecticut is very fine in texture and is used in the manufacture of ornamental brass and bronze castings, replacing the imported French sand used for this purpose. Berlin sand from Wisconsin is strong, of fine, even grain size, and is excellent for use in making light brass and aluminum castings. Illinois sands are similar to those of Indiana, but usually run higher in clay content. Sands from Rockdale, Galena and Carpentersville are used throughout the state.

ANALYSES OF TYPICAL AMERICAN FOUNDRY SANDS

	Per cent. composition							
Locality	Silica SiO_2	Iron Oxide Fe_2O_3	Alumina Al_2O_3	Lime CaO	Magnesia MgO	Alkalies K_2O+Na_2O	Sulphuric Anhydride SO_3	Physical Condition
Tennessee	92.96	3.10	4.92	.....	.....	0.26	.....	Weak
Long Island	89.16	2.92	4.66	.....	0.33	0.33	.....	Weak
New York	82.34	4.24	8.50	0.96	0.40	1.79	0.54	Strong
Indiana	82.50	2.70	8.90	0.16	0.61	1.47	.....	Strong
Wisconsin	82.87	2.67	8.45	0.80	0.89	1.00	trace	Strong
Indiana	79.66	9.47	3.36	1.34	0.68	2.50	.....	Strong
South Carolina	79.30	4.10	10.70	1.19	1.29	.....	.....	Strong
Kentucky	76.16	4.24	12.02	.....	0.72	1.21	.....	Strong
Ohio	77.14	6.44	9.20	trace	0.91	1.10	.....	Strong
Illinois	75.70	13.46	3.00	0.60	1.08	2.15	0.19	Strong
Illinois	56.80	5.09	14.43	6.40	5.60	3.15	0.14	Strong

Preparations and Requirements of Foundry Sands

There are three general classes of work for which the two types of sands are used. Sand containing little or no natural bonding material is used for making dry sand cores and synthetic molding sands. Sand containing natural bonding material is used to some extent in making cores but mainly as a molding sand. In a general sense, baked sand cores include all sands shaped in a moist state and baked to retain this shape, while molten metal is poured directly into molds of moist synthetic and natural molding sands.

Baked Sand Cores

The coremaker must have a suitable material in order to make the necessary shapes required, and this material must have sufficient strength to support itself before being baked. Ordinary silica sand, when mixed with water, linseed oil, Rosinal, or commercial core oil, will only be able to support its own weight to a height of 2 or 3 in., while it may be necessary to make a core 5 or 6 ft. in height. In order to accomplish this it is often necessary, in addition to metallic reinforcements, to add clay, flour or natural molding sand containing clay to secure a high green-sand strength. The use of clay increases the required amount of oil binders and results in a more difficult core to remove from the casting.

The core, when baked and ready for use, requires sufficient strength to support itself and to maintain its position while under pressure of the molten metal. The heat of the metal should ignite the bonding material in the core and after the mold has cooled the core should break up and fall out of the casting readily. The baked core must also be porous in order to allow the gases from the metal, and from the core itself, to escape.

Bonding Materials. There are a number of materials used to produce this dry-sand strength and burning-out quality. Wheat flour is composed of varying proportions of gluten, starch, fat, water and ash, depending on the grade; the higher the gluten and starch content the more effective as a binder. The high ash content of the shorts, offals, and sweepings exclude them as effective binders. Wheat flour is not used as extensively as in the past. The disadvantages of wheat flour as a binder are: 1. The binder itself molds, and deteriorates in storage readily. 2. Cores draw moisture readily and lose their strength. 3. Cores have a tendency to swell and distort. 4. During baking and pouring, wheat flour gives off objectionable noxious gases. Corn flour is replacing it as a green bond, and pitch and oil are replacing it in large cores because of their resistance to the absorption of moisture. In mixing wheat flour a bond ratio is obtainable with a clean silica sand of one part flour to from 12 to 20 parts sand.

Corn flour contains a high content of starch, dextrine and water soluble extract. It may be used alone as a binder, but it is more frequently used along with other binders to give a green bond strength to the mix. It has considerable dry strength, and when used in conjunction with other binders the other binders can be reduced materially, provided they are mixed and baked properly. Corn flour bond can be used effectively with clean open silica sand, molding sand or combinations of both. Bond ratios of from 1 to 25 and 1 to 50 by volume are employed when corn flour is used alone. A mixture for small cores for gray iron castings is as follows:

90 parts clean open silica sand.
1 part good grade core oil.
4 parts corn flour.

Medium and heavy cores for gray iron castings:

80 parts clean open silica sand.
1 part good grade core oil.
1½ parts corn flour.

Cores for aluminum castings:

10 parts clean new silica sand.
10 parts new molding sand.
30 parts foundry sweepings.
1 part corn flour.

Linseed oil, either boiled or raw, with additions of rosin, is probably the most widely used core oil. The oil may be used for nearly all classes of small and medium work. Compounded commercial core oils are gradually replacing linseed oil and may be used for the same class of work. Commercial oils are a mixture of various oils with linseed oil as a base. These various

oils are added as driers, filler, spreaders and catalysts with the idea of producing a combination that will be less viscous, easier to manipulate, and at the same time give a bond value that is commensurable with linseed oil and at a lesser cost. Linseed, chinawood, cotton seed, sunflower and other vegetable oils along with whale and fish oils are considered drying oils. Petroleum, tar and rosin oils are used as fillers and spreaders. The oils employed as fillers are used primarily to reduce the viscosity and accelerate the distribution of the bonding constituents of the mixture. Manufacturers of commercial core oils claim that, properly blended, they are more efficient and economical than pure linseed oil. Lack of uniformity in the commercially blended oils is the greatest difficulty encountered, but with modern methods of compounding and scientific control this difficulty has been reduced to a great extent. The high-grade core oils may give practically the same bond ratio as pure linseed oil. Clean, open silica sands give the best bond ratios, which will range from 1 to 50 to 100 by volume. Excessive fines, clay, lime and alkalies in the sand greatly reduce the effectiveness of the binder and cause reduced bond ratios of from 1 to 25 to 1 to 50.

Machine Mixing Best

Mixing Practice. Core sands are best mixed by machinery in the muller type machine which consists of a heavy roller rotating in a stationary pan. Paddle mixers and screens are also used, but do not mix the sand and compounds as thoroughly as the muller type mixer.

Baking Practice. The usefulness of the core in service depends upon the baking process. Ovens equipped with automatic temperature control are gradually replacing the old type. The temperature within the oven must be such that no matter how long the core is left in the oven, it cannot be burned, that is, have all the binder burned out of it. Corn and wheat flour cores rapidly disintegrate at 500 deg. F., while oil-bonded cores will stand from 600 to 700 deg. The recommended baking temperature for cereal-bonded cores is 325 deg. F. and from 450 to 500 deg. F. for oil-bonded cores. Baking time of 1 in. per hour is commercial practice at 450 deg. F. with correspondingly shorter or longer time with varying temperatures.

Synthetic Sand

Aside from the addition of kaolin to natural silica sand in preparing synthetic sands there are a number of natural and commercial binders available, such as Bentonite, Revivo and others. Bentonite is a natural clay of exceptionally plastic qualities. It will absorb water to the extent of three times its weight and seven times its volume. It is found mainly in Wyoming, while smaller deposits have been found in California, New Mexico, Arizona, Utah, Montana, Idaho, South Dakota, Texas, Tennessee and Indiana. It is used extensively in the ceramic industry and is becoming popular in the foundry. A typical analysis of this material is as follows:

Constituent	Per cent. A	B	C
Silica (silicon dioxide, SiO_2)	57.96	63.20	55.22
Alumina (aluminum oxide, Al_2O_3)	22.46	12.90	21.00
Iron oxide (ferric oxide, Fe_2O_3)	3.80	2.46	3.61
Titania (titanium oxide, TiO_2)	.....	0.11	.....
Lime (calcium oxide, CaO)	1.92	0.82	4.94
Magnesia (magnesium oxide, MgO)	3.24	2.09	3.04
Alkalies (potassium and sodium oxides, $K_2O + Na_2O$)	1.25	0.92	1.56
Sulphuric anhydride (SO_3)	0.75	.....	0.43
Water (H_2O)	.....	13.80	10.28
Loss on ignition	7.93	3.70	.....

Molding Sand

Inasmuch as mold cavities are formed of sand and are subjected to high temperatures, it must be first understood just what properties a sand must have to produce castings under varied conditions. In the first place, the sand in the completed mold must have sufficient molding plasticity to allow the pattern to be withdrawn from its mold cavity and sustain the flow and pressure of the molten metal. It must have sufficient porosity to allow the escape of gases from the metal, and those generated within the mold. The sand must have a texture of such nature as to produce a satisfactory surface finish, and must have sufficient durability in repeated service. If one keeps these four factors in mind and realizes that they must correlate to produce a sound casting of satisfactory size, shape and finish he may readily understand the necessity for careful control within fixed limits of foundry sand properties.

Some Moisture Needed

General. In order to make these sands workable a certain percentage of moisture must be maintained. This moisture content varies with the kind of clay in the sand, but for general light gray-iron work the moisture will run about 6.5% and for brass about 1% higher. It has been found that in the Western Electric Co.'s foundry a shear strength of 0.7 lb. per sq. in. and a compressive strength of 2.0 lb. per sq. in. on the green sand produces satisfactory results for light and medium gray-iron castings. In the brass foundry the strength is found to be 1.5 lb. per sq. in. in shear and 5.0 lb. per sq. in. in compression.

(1) *Permeability.* Green sand must be sufficiently open to permit the escape of gases from the metal and steam from the sand. Using the standard American Foundrymen's Association permeability testing machine, the following limits have been set up:

Class of work	Permeability
Aluminum castings, light and medium	10-18
Brass castings, light	13-19
Brass castings, medium	19-23
Brass castings, heavy	23-30
Gray iron, light, hand rammed	25-30
Gray iron, light machine	20-25
Gray iron, medium	30-36
Gray iron, heavy, average floor	42-50
Gray iron, heavy, machine base castings	60-80

(2) *Strength.* In pouring brass at 2150 deg. F. into a green sand mold at room temperature, the surface of the mold is skin dried by the advancing stream of molten metal. If the dry sand is weak, it will be washed from the surface and into the metal, causing a porous casting. It is therefore important that the dry sand strength be controlled. Moisture plays a very important part in dry sand strength. The following table shows results obtained on a coarse-grained, open sand.

EFFECT OF MOISTURE ON DRY STRENGTH

Moisture per cent.	Dry strength pounds per square inch
4.0	1.2
5.0	2.4
6.0	5.6
6.5	6.8
7.5	7.5
8.0	8.1
8.5	8.9
9.0	9.7
10.0	10.4

(3) *Mixing.* An experiment was conducted on the effect of mixing molding sand with a shovel and in a No. 1 Simpson mixer (muller type). The sand was divided into two piles and a handful of new sand added to each 500-lb. heap. One heap was cut several times with a shovel while the other was placed in the mixer. The first results noted were the amounts of dispersion of the new sand in each heap. Shovel mixing showed small particles of new sand spread rather unevenly throughout the heap. The sand was lumpy and bits of cores and scale from castings were in evidence. Physical tests on checked samples taken from four different sections of the heap showed the following:

Sample	Relative permeability	Shear strength	Per cent. moisture
A	12	1.5	11.2
B	7	1.3	10.7
C	11	1.1	10.6
D	11	1.3	10.7
Average	10.3	1.3	10.8

The other heap was mixed by machine for 15 minutes. Using the average values of shovel mixing as a basis, the following results were obtained:

Time of mixing	Relative permeability	Shear strength	Per cent. moisture
0 min.	10.3	1.3	10.8
2 min.	11.0	1.8	10.65
4 min.	11.0	1.9	10.45
6 min.	12.0	1.5	10.45
15 min.	12.5	1.1	10.20

Under normal circumstances sand may be prepared by this method in three minutes,

while longer mixing reduces the green sand strength, and, on a warm day, reduces the moisture content to some extent. After two minutes' mulling no trace could be found with the eye of the new sand condition. The sand was of a uniform color and light and fluffy. Checked physical tests from various parts of the mix showed uniform conditions after two minutes mixing. These tests have conclusively shown the advantages of machine mixing.

(4) *Grain Size.* A very important property to be considered in choosing the proper sand for a job is its grain fineness. The fineness plays an important part in the control of permeability and strength and has an added quality, finish. A coarse sand will produce a rough finish, while a finer sand will produce a smooth finish with a corresponding reduction in permeability and increase in strength. The following tables show sand testing reports from our brass foundry over an extended period. The fineness tests were made by drying the sand for one hour at from 220 to 240 deg. F., screening in a Rotap machine for 15 minutes with standard American Foundrymen's Association screens. Inasmuch as the clay was not removed from the sand, the results vary somewhat with the moisture content, and with variations in drying time and temperature. The samples were taken from each hopper of a sand handling system with a centralized mixing unit at 4 p. m. of each day.

BRASS FOUNDRY TESTING REPORT

Per cent. retained on each sieve No.	Date 12/17	12/18	12/23	12/26	12/30	12/31
6	.....	.....	.....	0.33	.....	.....
12	0.94	.....	0.23	0.87	1.04	1.64
20	4.29	4.27	2.60	3.15	2.73	2.80
40	5.19	5.07	4.10	4.50	4.57	4.30
70	13.60	10.12	10.60	11.50	10.25	8.50
100	19.24	14.25	14.25	13.80	12.22	10.80
140	18.65	15.20	17.90	18.80	16.10	10.40
200	15.75	13.25	14.85	15.35	14.80	13.00
270	8.88	13.22	13.00	11.76	14.25	13.90
Pan	13.01	24.60	22.40	20.10	24.10	35.10
Fineness No.	130	149	147	139	151	174
Permeability	20	19	22	23	19	17
Green shear	1.9	2.0	2.0	2.0	2.1	2.3
Green compression	8.5	8.4	6.9	7.8	7.5	8.0
Per cent. water	8.1	6.9	7.2	.....	.....	.....

Per cent. retained on each sieve No.	Date 1/2	1/3	1/4	1/6	1/8	1/0
6	.....	0.23	.....	.....	.....	.....
12	1.87	1.44	0.92	0.63	0.78	0.49
20	3.97	3.10	2.70	1.46	1.60	1.28
40	5.40	5.10	4.20	3.20	3.00	2.68
70	8.50	9.20	9.55	9.40	7.50	7.30
100	10.20	11.70	13.50	11.50	13.50	14.82
140	11.60	15.00	19.70	17.10	19.00	22.15
200	12.50	17.10	19.60	15.90	18.40	19.75
270	11.76	14.25	13.90	14.60	12.30	13.50
Pan	30.60	23.30	17.40	29.00	22.40	18.06
Fineness No.	162	159	138	162	153	145
Permeability	16	18	20	18	21	23
Green shear	2.0	1.9	1.8	1.7	1.9	1.7
Green compression	10.1	6.5	7.5	8.3	6.7	6.8
Per cent. water	7.0	7.7	7.3	6.4	6.7	6.3

Per cent. retained on each sieve No.	Date 1/13	1/14	1/15	1/16	1/17	1/18
6	.....	.....	.....	.....	.....	.....
12	0.94	1.20	0.74	0.33	0.88	0.39
20	1.40	1.70	1.65	1.10	1.94	1.79
40	2.60	3.20	3.10	2.90	3.66	3.90
70	7.60	10.50	11.60	10.40	14.40	14.30
100	15.30	19.20	19.80	17.50	22.90	23.70
140	21.50	27.00	26.00	23.80	25.00	24.60
200	18.90	16.50	17.20	19.00	14.20	13.60
270	12.00	8.40	9.00	10.70	6.90	6.95
Pan	18.00	12.30	11.20	14.00	10.70	9.70
Fineness No.	143	130	110	131	113	111
Permeability	20	22	17	20	20	24
Green shear	1.8	1.4	1.6	1.6	1.5	1.3
Green compression	7.4	5.1	6.6	5.4	6.0	5.8
Per cent. water	6.9	6.7	7.2	6.8	8.0	7.9

The corresponding scrap reports show an increased number of blow holes and miss-run castings with a low permeability, and an increasing number of castings containing sand holes with sands containing a greater percentage of fines. This condition was corrected by increasing the average grain size, resulting in higher production, sounder castings and the elimination of defectives to their normal small amount.

As a result of tracing scrap losses, it has been found that an excess of water and clay tends to produce cold shuts, scabs, miss-runs and blow holes, while too little moisture or clay will cause washed sand, rough castings due to sand sticking to the pattern, sand holes, drops and swollen or oversize castings.

Sand Testing and Control Equipment

Until a few years ago there were no standard methods for testing and controlling molding sands. To be sure, a large number of progressive foundries had produced testing and control equipment for their own use, but the American Foundrymen's Association has been instrumental in standardizing molding sand tests and equipment.

(1) *Moisture.* Perhaps the most accurate method of testing sand for moisture is that of drying a weighed sample in an oven and reweighing when dry. However, this method takes considerable time and for control work, moisture must be determined instantly. By using a constant weight of sand and ramming it on a standard AFA machine, it has been found that the length of the rammed sample is proportional to the moisture content. Consequently by calibrating the ramming machine, relative moisture may be determined in a few seconds. This method has been found to vary from day to day inasmuch as there are so many variables that may affect the weight and length of the sample. Under certain conditions this method has proven satisfactory. The company manufactures a relative moisture indicating machine based on the varying electrical conductivity of molding sand with varying moisture content. In one type used for sand in the heap, the instrument is pushed into the heap at several points and the average reading taken on a milliammeter. By calibrating the milliammeter scale with the actual moisture content of the sand by the oven method, the relative moisture values are determined. The instrument may be satisfactorily used on sands of similar physical properties. Another type consists of two electrodes suspended in a mixer and dragging through the sand. By maintaining a sand of uniform properties and by adding a uniform charge to each mixer the moisture may be controlled within close limits.

(2) *Permeability.* The standard AFA permeability machine consists of a constant-pressure air tank holding 2000 cc. of air. By passing this air under pressure through a sample of rammed sand in a tube the time of flow and the back pressure caused by the sand may be recorded, and the permeability factor calculated. Inasmuch as a standard sample, 2 in. long and 2 in. in diameter is used, the number of variable factors is reduced and by calibrating the manometer the permeability factors may be read directly from the back pressure produced by the sand. As the back pressure increases, the permeability decreases, showing that the sand resists the passage of air through the tube.

(3) *Strength.* In determining the shear strength of sand, the standard 2-in. rammed sample is placed in one of two machines. The sand when placed under load breaks in the center to form a plane surface 2 in. square. The Cornell machine applies this pressure through a piston pressing against an oil chamber, and the corresponding pressure read on an oil gage. The other machine was designed by H. W. Dietert of the United States Radiator Co. and consists of a heavy weight suspended as a pendulum. In the vertical position no load is placed upon the sand sample, while as the pendulum is swung upward the load increases. Compression strength may also be determined by this machine or by placing the sample on a scale and adding weight to the upper surface of the sample. The Dietert dead weight machine is the most accurate, in that no springs are used and the change of temperature has practically no effect.

(4) *Cohesive Test.* The cohesive test is made by placing a rammed sample 12 in. long, 2 in. wide and 1 in. thick on a plate and allowing one end to protrude off the edge until broken by its own weight. By weighing the broken portion a relative cohesive factor may be obtained.

(5) *Clay.* The present AFA method for determining per cent. of clay in sand consists of washing the clay out of the sand and holding it suspended in an alkaline solution. By removing this solution the remaining silica grains may be weighed and the per cent. clay determined. This method has been found to be fairly accurate with coarse grained sands, but with sands under 140-mesh, a wide variation in results may be obtained with probably none of them being correct. An effort is being made to formulate a suitable method of separation of clay from fine sands, but no satisfactory results have as yet been obtained. A chemical analysis will show accurately the percentage composition of the sand and clay substances, but gives no assurance that the material is active as a bonding material in the prepared sand. Eugene Smith, superintendent of foundries, Crane Co., has developed a method whereby the sand sample is mixed with water and vibrated until the heavier particles have settled out. The smaller particles are then allowed to settle out and the resulting demarcation is said to be the relative bond strength of the sand. This again is fairly consistent with coarse sands but with fine particles present these cannot be distinguished from the slow settling clay.

CLAY CONTENT CLASSIFICATION

Clay class	Clay content zone
A	0.0% to but not including 0.5%
B	0.5% to but not including 2.0%
C	2.0% to but not including 5.0%
D	5.0% to but not including 10.0%
E	10.0% to but not including 15.0%
F	15.0% to but not including 20.0%
G	20.0% to but not including 30.0%
H	30.0% to but not including 45.0%
I	45.0% to but not including 60.0%
J	60.0% to 100.0%.

(6) *Grain Fineness* is determined by shaking the sand that has been washed free from clay through a series of standard American Foundrymen's Association screens. Heretofore this test has only been used in the purchase of new sands. The writer conducted a number of fineness tests on brass foundry sands with and without removing the clay, and found that the grain size taken without removing the clay varied with changes in permeability of green sand. By studying this relation over a period of several weeks definite control limits were set up. When too large a percentage of fines is present, the scrap in the foundry increases, and when the sand becomes too coarse, the scrap also increases. It was found that, although the average grain size remained constant, it was possible to vary the fine and coarse grains in such a way as to produce either good or bad castings. It was finally determined that, for the best results for brass and aluminum castings, at least 60% of the grains must be caught on the 70-, 100- and 140-mesh screens, and from 15 to 18% must be caught on the 200-mesh screen with not more than 25% passing through. Variations in baking time and temperature and in screening time produced varying results, so that it is necessary to maintain uniform test conditions. All samples are dried one hour at from 220 to 240 deg. F., and screened in a Rotap machine for 15 minutes.

It has been claimed that in screening sand without removing the clay, the clay particles are broken off from the grains and are caught as very fine material. The writer has maintained that the grain fineness determined in this manner is more representative of the sand as used by the molder. There is a tendency toward the breaking off of the clay, but this feature has been exaggerated. In order to study this condition, the sand remaining on each screen was placed in bottles containing a 5% solution of sodium hydroxide and thoroughly washed. The bottles were then vibrated to allow the heavy sand particles to settle out and hold the clay in suspension. After the bottles had been allowed to settle for 24 hours a distinct separation of sand and clay was visible. The following table shows the results obtained by the vibratory test for each grain size:

Grain size	Per cent. sand	Per cent. clay
12- 20	94	6
20- 40	80	20
40- 70	77	23
70-100	70	30
100-140	75	25
140-200	85	15
200-270	90	10
270-finer	62	38
Before screening	72	28

The results of this test show that the clay does stick to the sand grain when properly dried, and that it is much more firm on those grains of the sizes most desired for this type of work. Grain size has become an important daily control feature in the brass foundry at the Western Electric Co.

In order to determine the average fineness, the following method is used: The per cent. of sand remaining on each screen is multiplied by a corresponding factor. This product is totaled and the result divided by 100 to give the average grain fineness.

Per cent. remaining on screen number	Multiplying factor
6	3
12	5
20	10
40	20
70	40
100	70
140	100
200	140
270	200
Pan	300

—Grain fineness classification—

Grain class No.	Fineness zone
1	200-mesh
2	140 to but not including 200
3	100 to but not including 140
4	70 to but not including 100
5	50 to but not including 70
6	40 to but not including 50
7	30 to but not including 40
8	20 to but not including 30
9	15 to but not including 20
10	10 to but not including 15

(7) *Durability.* In order to determine the durability of a sand, a sample is made up and placed in a sealed container, in order to allow water added to permeate the sand uniformly. This sand is then tested for physical properties and a mold made in a 12-inch section of 6-in. pipe using a 2-in. diameter bar 8 in. long as a pattern. Molten metal is poured into the cavity, the casting removed and the sand returned to the container. It is corrected to the predetermined moisture content and again tested for physical properties. This process is repeated, the corresponding data showing the effect of the repeated casting on the properties of the sand.

By testing the fusion temperature of the sands, the relative value of the bonding material may be determined. In order for clay to have plastic properties, it must retain its water of crystallization. The heat of the metal removes this to some extent and there is always a certain amount of inert clay carried along with the molding sand. The relative value of the plastic properties of the clay may be determined by dehydrating at 1800 deg. F. The dehydration test used in connection with the durability test shows quite conclusively the value of the sand for repeated use in the foundry.

Conclusion

Introduction of controlled properties of molding sand has contributed to the realization of a more positive control of casting technique. By the use of suitable sands the scrap losses may be reduced, and result in an improved quality of castings. Accurately controlled sand properties bear a close relation to an increased rate of production.

New Gravel Plant in South Carolina

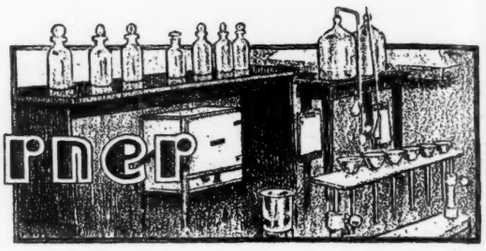
THE RICHMOND SANGRAVEL CO., a new corporation chartered recently at Augusta, Georgia, will erect a plant in 30 or 40 days, it was announced here April 26 by L. S. Moody, secretary of the local chamber of commerce. Officers of the company are John G. Ehrlich, president, and John W. Wilson, vice-president.

The owners have purchased 11½ acres adjacent the beltline railroad and the New Savannah road, where the plant will be erected, the work to begin as quickly as material can be placed on the site. B. O. Edmondson will be superintendent.

According to Mr. Moody, the plant will have a capacity of 20 cars of sand gravel per day. Production will start within a month.

Mr. Ehrlich is also president and treasurer of the Southern Silica and Mining Co. of Columbia. Mr. Wilson is vice-president of the S. W. Wilson and Sons, large operators in the sand gravel business in South Carolina. Both officers have been in this business for 12 years. J. W. Wilson will move to Augusta.—*Augusta* (Ga.) *Chronicle.*

The Chemists' Corner



Application of Certain Formulas for Rotary Kiln Capacities

By Alton J. Blank

General Superintendent and Supervising Chemist, Compania de Cemento Portland "Landa," S. A., Puebla, Puebla, Mexico

FORMULAS made use of in certain parts of England for calculating the capacities of kilns burning portland cement clinker by the wet-process are two in number and read as follows:

FORMULA No. 1—For wet-process kilns fed with slurry spray feeds—"0.02 cwt. of clinker per kiln hour per cubic foot of internal capacity."

FORMULA No. 2—For wet-process kilns fed with ferris-wheel and spoon feeds—"336 lb. of clinker per kiln hour per 100 sq. ft. of heating surface."

As a basis for comparison, the actual capacities of 33 English wet-process kilns are shown with their actual internal capacities in cubic feet and their outputs in hundredweights of clinker per cubic foot. At the same time the actual capacities of 24 English wet-process kilns are shown with their actual area in square feet of heating surface and their outputs in pounds of clinker per 100 sq. ft. of heating surface.

TABLE 1—SHOWING OUTPUTS OF 33 ENGLISH, WET-PROCESS CEMENT KILNS, IN CWTS. OF CLINKER PER KILN HOUR PER CUBIC FOOT OF INTERNAL CAPACITY

Kiln dimensions	Total internal capacity in cubic feet	Cwts. per kiln hour per cu. ft. internal capacity
5 ft. 4 in. x 130 ft.	.....	0.0175
6 ft. 0 in. x 60 ft.	1,298	0.0259
6 ft. 6 in. x 98 ft.	2,401	0.0200
6 ft. 11 in. x 140 ft.	4,165	0.0170
6 ft. 3 in. x 130 ft.	4,007	0.0174
6 ft. 7 in. x 106 ft.	2,640	0.0190
6 ft. 5 in. x 132 ft.	.....	0.0205
6 ft. 3 in. x 130 ft.	.....	0.0172
7 ft. 10 in. x 130 ft.	.....	0.0175
7 ft. 10 in. x 164 ft.	6,472	0.0177
8 ft. 0 in. x 130 ft.	4,014	0.0158
8 ft. 0 in. x 141 ft.	4,200	0,0160
8 ft. 0 in. x 132 ft.	.....	0.0174
8 ft. 0 in. x 132 ft.	4,325	0.0198
8 ft. 0 in. x 155 ft.	5,143	0.0163
8 ft. 6 in. x 202 ft.	9,700	0.0153
8 ft. 10 in. x 200 ft.	.....	0.0180
8 ft. 10 in. x 228 ft.	10,890	0.0164
9 ft. 0 in. x 202 ft.	9,900	0.0158
9 ft. 0 in. x 200 ft.	9,820	0.0152
9 ft. 0 in. x 202 ft.	10,100	0.0177
9 ft. 0 in. x 206 ft.	8,096	0.0165
9 ft. 0 in. x 130 ft.	.....	0.0162
9 ft. 1 in. x 198 ft.	6,137	0.0210
9 ft. 1 in. x 165 ft.	6,392	0.0175
9 ft. 10 in. x 200 ft.	10,340	0.0195
10 ft. 0 in. x 202 ft.	9,650	0.0167
10 ft. 0 in. x 202 ft.	10,100	0.0167
10 ft. 0 in. x 202 ft.	10,536	0,0152
10 ft. 3 in. x 250 ft.	.....	0,0172
10 ft. 0 in. x 245 ft.	.....	0.0176
11 ft. 2 in. x 245 ft.	14,656	0.0177
11 ft. 6 in. x 250 ft.	16,655	0.0174

Perusal of the tables of kiln outputs shows the average kiln outputs in cwts. per cu. ft. of internal capacity to be 0.0177, or 88.5% of the formula capacity of 0.02 cwt. of clinker per kiln hour per cu. ft. of internal capacity.

Perusal of the tables of kiln outputs shows the average kiln outputs per 100 sq. ft. of heating surface to be 310 lb., or 92.2% of the formula capacity of 336 lb. of clinker per hour per 100 sq. ft. of heating surface.

Data included in Tables 1 and 2 consist of average results obtained over a period of six months as abstracted from a half-yearly operating report.

For comparison of kiln outputs with different types of feeding systems, the following is given:

TABLE 2—SHOWING OUTPUTS OF 24 ENGLISH, WET-PROCESS CEMENT KILNS, IN POUNDS OF CLINKER PER KILN HOUR PER 100 SQ. FT. OF HEATING SURFACE

Kiln dimensions	Total area in sq. ft. of heating surface	Lb. clinker per kiln hour per 100 sq. ft. surface
6 ft. 0 in. x 60 ft.	990	339
6 ft. 6 in. x 98 ft.	1726	281
6 ft. 11 in. x 140 ft.	2690	265
6 ft. 3 in. x 130 ft.	2538	276
6 ft. 7 in. x 106 ft.	1750	288
7 ft. 10 in. x 164 ft.	3627	315
8 ft. 0 in. x 130 ft.	2548	255
8 ft. 0 in. x 141 ft.	2440	274
8 ft. 0 in. x 132 ft.	2659	328
8 ft. 0 in. x 155 ft.	3165	269
8 ft. 6 in. x 202 ft.	5130	288
8 ft. 10 in. x 228 ft.	5639	321
9 ft. 0 in. x 202 ft.	4970	314
9 ft. 0 in. x 200 ft.	4965	306
9 ft. 0 in. x 202 ft.	5357	339
9 ft. 0 in. x 206 ft.	4190	318
9 ft. 1 in. x 198 ft.	3900	261
9 ft. 1 in. x 165 ft.	3640	302
9 ft. 10 in. x 200 ft.	5121	400
10 ft. 0 in. x 202 ft.	5130	319
10 ft. 0 in. x 202 ft.	5357	312
10 ft. 0 in. x 202 ft.	5450	293
11 ft. 2 in. x 245 ft.	6820	384
11 ft. 6 in. x 250 ft.	7350	401

TABLE 3

Kiln dimensions—8 ft. 10½ in. x 9 ft. 10½ in. x 200 ft.
Cubic feet of internal capactiy—10,340.

Feeding system	Output—Cwts. per cu. ft. internal cap.
Registered output	0.0144
With spoon feed and lifters	0.0161
With spoon feed—no lifters	0.0167
With slurry spray feed	0.0207

Perusal of the data contained in Table 3 shows that the use of spray feeds results in an increase in output of 43% over the registered output.

TABLE 4

Kiln dimensions—6 ft. 5 in. x 9 ft. x 134 ft.
Cubic feet of internal capacity—4325.

Feeding system	Output—Cwts. per cu. ft. internal cap.
Normal output	0.0158
With spoon feed	0.0177
With slurry spray feed	0.0208

Perusal of the data contained in Table 4 shows the use of spray feeds to result in an increase in output of 31% over normal.

The formula used by S. H. Harrison, when applied to over 40 English wet-process cement kilns, of which those kilns shown in Tables 1 and 2 are a part, is found to check the actual outputs very closely. In fact, in assuming the average thickness of the kiln brick in these kilns to be 6 in., Mr. Harrison's formula checks their actual capacities within 2%.

Mr. Harrison's formula is as follows:

$$C = 0.6DL$$

Where C = capacity per 24 hours in 380-lb. clinker.
D = inside diameter of the kiln in feet.
L = the length of the kiln in feet.

Vermont State Geologist Report

AS NEW METHODS of separation have been found work by the Vermont Asbestos Corp. is being carried on with new vigor, says the 1929-30 report of George H. Perkins, state geologist of Vermont. In past years production of asbestos in the state has not been profitable. It is possible that it may now develop into a valuable mineral resource. It is also reported that little activity is taking place in the mica and talc industries. In the lime industry there are many old and small kilns in the state. Most of these kilns have been abandoned and a small number of modern plants now supplies the demand for this product.

Universal Gypsum and Lime Announces Promotions

THE Universal Gypsum and Lime Co., Chicago, Ill., announces the promotion of W. S. Brown to its general sales department in Chicago. Mr. Brown has been identified with the Universal company for the past several years as a salesman and recently as sales manager of the Northwestern division. His broad experience in the gypsum and lime industries and his knowledge of field conditions and dealers' problems make him well qualified to handle his new work.

The company also announces the appointment of George H. Chamberlain as manager of the Northwestern division, to succeed Mr. Brown. Mr. Chamberlain is also an old employe of the company and has been in charge of the Milwaukee district.

The changes mark a definite expansion program on the part of the Universal company, it is stated. It recently opened a new division sales office in Pittsburgh, Penn., with O. C. Cronwell in charge. It has also opened new offices in Dallas, Tex., and Minneapolis, Minn.

New Lime Putty Plant for Little Rock, Ark.

CONSTRUCTION OF A LIME PUTTY plant at Garland Ave. and Spring St. has been started by the Big Rock Stone and Material Co., Little Rock, Ark., John C. Eakin, sales manager for the concern announced April 16. Cost of the plant will be approximately $10,000. It is expected to be put into operation about May 15.

Capacity of the plant when first put into operation will be five carloads of lime, Mr. Eakin said, but the arrangement of the processing bins allows additions which will double the capacity when needed.

The plant will be the third in the state, but only one other is in operation at present. The production of lime putty in a plastic state is a relatively recent development in the building supply field, Mr. Eakin said. The plant will be modern in every respect.—*Little Rock* (Ark.) *Gazette.*

Mosaic Contractors Inspect Quarries at Whitestone, Ga.

WHILE at Atlanta, Ga., for their eighth annual convention, members of the National Terrazzo and Mosaic Contractors' Association inspected the Whitestone quarries of the Williams-Little-Stone Co.

The growing need for brightly colored marble chips, such as are produced in Georgia quarries, was described by Richard S. Knight of New York, president of the association.

More than 70% of all marble used last year in terrazzo and mosaic work came from Georgia, President Knight stated.

Robert C. Collins Leaves Warner Co.

"A HOST of friends in the Warner Co. wished Bob Collins 'Godspeed' on his new venture when he left the company on April 4 to take a position with a sand and gravel firm near St. Louis, Mo.," says *Warner-American News.* He has already gone to that city to take over the new job, and incidentally to locate the new Collins residence in the suburbs of St. Louis.

For the first year Mr. Collins will be chief of production, and according to present plans of that company he will take an executive position after that. When he relinquished

Robert C. Collins

his Warner title of general superintendent of the sand and gravel department, he remarked, "I hope that my work in St. Louis will make it possible for me to form friendships as true and lasting as I consider those which I have made while with the Warner Co."

Mr. Collins grew up with this company. He entered it in 1916, going to work for George Cornell as chief clerk in the Wilmington retail department. He was away a year in the army, but returned in 1919 to go "on the street" selling. In 1920 he combined his sales activity with the job of yard superintendent. Later he was made supervisor of marine and dredging operation. In July, 1925, he went to Manor plant, just established near Morrisville. The next year, in August, he returned to Philadelphia, where he remained as superintendent of the sand and gravel department until his resignation.

Mr. Collins says his new company has three dredges on the Mississippi river and two land plants, one at Jedburg, Mo., and the other at Pacific.

Fifty-six of his closest friends gathered in the Capers Room of the Penn Athletic Club, Philadelphia, on March 26 to give him a real send-off. President Charles Warner, Vice-President Irving Warner, and F. A. Daboll, director of publicity and personnel, expressed the feelings of the gathering and the entire company in short eulogies.

A silver service set was presented to Bob by Vice-President Alexander Foster, Jr.—a gift in which all present shared along with others in the company. An additional gift was presented for Mrs. Collins—a bouquet from a number of the Philly Office girls. Mr. Collins received both gifts gracefully for himself and his wife. His farewell remarks were brief but hearty.

Ross Louthan

ROSS LOUTHAN, aged 46, secretary-treasurer and general manager of the Northern Indiana Sand and Gravel Co., Wolcottville, Ind., died suddenly of apoplexy April 11 at his residence, 2615 West Drive. Mr. Louthan had been engaged in construction work for many years and was well known throughout Indiana.

Although he had not been in good health for the last six months, he was not taken seriously ill until 8 o'clock Friday night. Mr. Louthan was a thirty-second degree Mason; member of the Scottish Rite bodies and of the Mizpah Shrine of this city. He was a director of the Wayne Material Co. at the time of his death.

Mr. Louthan started his career as a water carrier for the Grace Construction Co. when a youth. He later became superintendent of the Grace Construction Co., and also was superintendent of the Western Construction Co. at Indianapolis for a time.—*Ft. Wayne* (Ind.) *Sentinel.*

Z. W. Davis

ZEBULON W. DAVIS, 87, wealthy inventor, and founder of the Diamond Portland Cement Co., of Cleveland, died of heart disease at his home in Canton, Ohio, May. 3.

His invention, with William Blake, of Bedford, of a gasoline lamp and a gasoline stove nearly 60 years ago laid the foundation of his fortune. He founded the cement company in 1892.—*Dayton* (Ohio) *Journal.*

Edward Balf Co. Buys Hartford Sand and Stone Co.

THE Edward Balf Co., Hartford, Conn., operators of a commercial crushed-stone quarry at Tariffville, Conn., and a sand and gravel plant at Newington, Conn., recently purchased the Hartford Sand and Stone Co., which operated a quarry at Farmington, Conn., and a sand and gravel plant at East Hartford.

The Hartford Sand and Stone Co. was one of the enterprises of the late J. H. Cooke.

Hints and Helps for Superintendents

Retrieving Discarded Gravel Boulders

THE Allen Gravel Co., Iuka, Miss., like numerous other gravel producers, for a long time wasted a considerable percentage of oversize, rather than install a

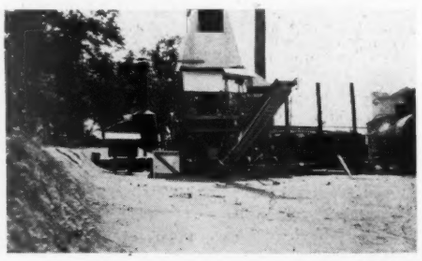
Crusher at waste boulder pile fed by clamshell buckets

crusher, or because there was no market for crushed gravel.

Recently this gravel producing company decided to put in a crusher, and the problem of retrieving the formerly discarded boulders arose. This has been solved very simply by building a bin or hopper with a crusher below, alongside the former waste pile of boulders and feeding the boulders to the bin with a crawler crane and clamshell bucket. The bucket elevator on the left removes the crushed material and loads cars standing on the track beneath the spout. The crushed material then goes through the plant with the material from the pit and is screened and delivered to bins. Sam H. Allen is the general manager.

Handling Hot Asphalt Mix on a Belt Conveyor

THAT prepared hot asphalt mix for black top road construction can be successfully handled on a belt conveyor is evidenced



Black top road plant uses belt conveyor

from a recent news item released by the Link-Belt Co. A number of quarries are now preparing such mixes.

The mixture of asphalt, sand and stone screenings, at a temperature of 200 deg. F. is handled by a portable belt conveyor direct into railroad cars or on to a stockpile, at the Western Asphalt Paving Co. plants at Richmond, Va., and Lancaster, Penn.

This mixture is somewhat sticky and is quite abrasive. The pug mill discharges a 1000-lb. batch to the loader about every 2 min. This sudden load, it is said, causes the conveyor to hesitate slightly, but in a few seconds, the motor has recovered full speed and the batch is over the head pulley. The idlers are Timken roller bearing equipped and have no difficulty in handling batches.

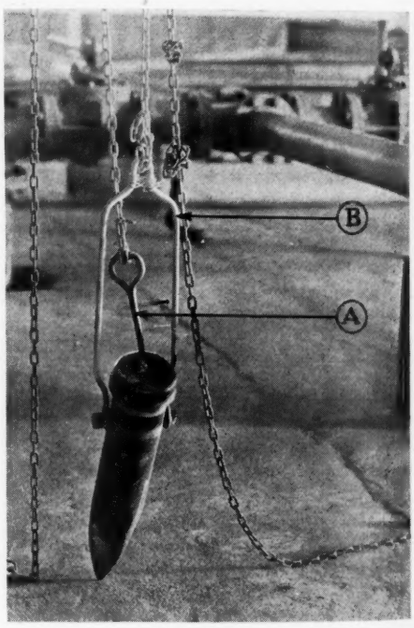
Air-Operated Bin Gates

THE ACCOMPANYING illustration shows how the flux-stone bin gates are controlled by compressed air at the Steelton plant of the Bethlehem Mines Corp.

The cars are spotted below the various gates and from a platform alongside, the operator can open or close the quadrant gates by means of an air valve.

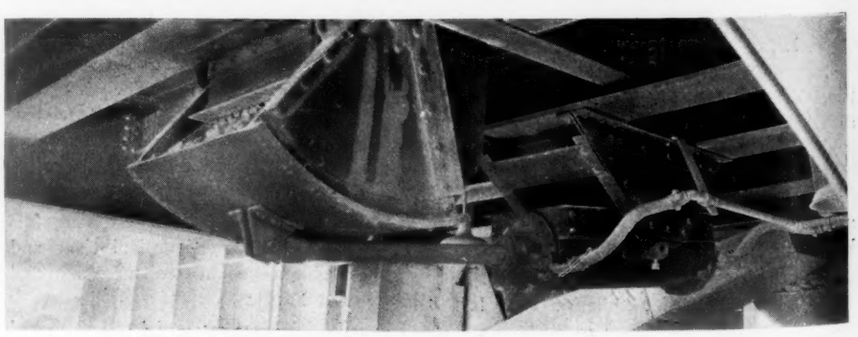
Slurry Sampler

THE accompanying picture shows how the chemists at the Hull, Que., plant of the Canada Cement Co., Ltd., can secure a sample of slurry at any desired depth in the tanks.



Gets slurry sample from any depth

The main body of the sampler is a piece of 3-in. pipe with a 1½-in. hole drilled in standard pipe cap.



Bin gates controlled by air

The sampler is lowered to any desired depth by line *A*, on the end of which is a ball, closing the hole in sampler when the line is taught. The sample is then taken by slacking off on line *A* and carrying the weight on line *B*, after which line *A* is used to bring the sample to the surface. The steel ball on the end of line *A* acts as a seal.

Novel Device for Repairing River Floating Equipment

THE TENNESSEE VALLEY Sand and Gravel Co., with offices at Sheffield, Ala., and a dredge on the Tennessee river, is extending its operations along several hundred miles of this waterway. Often it became necessary to repair a barge, dredge or some of the floating equipment, and to move one of these upstream several hundred miles, bucking considerable current, would cost excessively. To overcome this difficulty Capt. J. S. Wilson constructed what he calls "needle ways" at Dam No. 1, of the locks provided for shipping through the Wilson Dam.

At a time when the lock was at a low water level he placed four steel I-beams below the water level concreting the lower ends and otherwise securing the portions below water. These are inclined at about 18 deg. from the horizontal, and the lower beams, four in number, are each 30 ft. long. They are 30-in. steel I-beams. The four ways are spaced at 25 ft. centers.

Above the water level he has continued the I-beams for a 28-ft. length at each point. The upper beam rests on a fulcrum near the center, so that the beam is about balanced and can swing upwards or downwards according to the location of the load.

Capstans on bank to pull barges from the water

On the bank above he has secured four capstans, it being expected that a horse or mule would be necessary at each capstan to pull the barges out of the water, but later it was found that man power could easily accomplish that part of the operation.

In the illustrations four 7/8-in. cables are looped around the hull of the barge, while still in the water. The loops, being equally spaced along the length of the hull, are then hooked to the blocks and tackle, at each capstan, and the crew pull the hull out of the water, so that the work to be done can easily be accomplished.

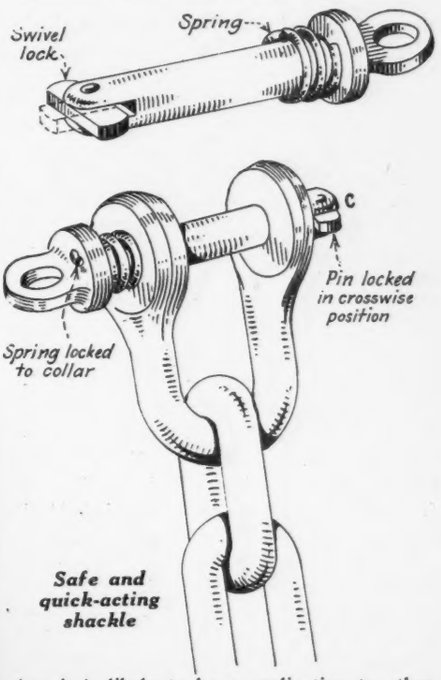
Later the entire hull will be pulled upon the balanced "needle ways," and when the load is properly placed on the four fulcrums the body of the dredge will assume a horizontal position. It can be pushed back into the stream with wedges.

It was said that the cost of the installation was less than $2600.

Cables are looped around the hull of the barge

Safety Clevis Pin Holds in Hard Service

A TYPE of safety shackle which I developed as an engineer officer in the U. S. Navy and used to a considerable extent on coaling-vessel equipment, is described in *Coal Age* by Charles H. Willey. "While this particular type may not be directly applicable to mine-car couplings, nevertheless it is likely to have application to other uses in and about the mines," he writes.



The shackle is of the regular type and is made both safe and quick-acting for both inserting and removal. As the sketch shows, the pin has a collar and an eye at one end, to which is attached a spring. The other end of the pin is slotted and has a pivoted lock bar in it as at *C*. When inserting the pin the bar is turned parallel with the body of the pin, which is pressed against the shackle to compress the spring and the lock bar turned crosswise into a holding position. These pins proved satisfactory and stood the rough naval service.

Slag Association Re-elects Officers

C. L. McKENZIE, president of the Duquesne Slag Products Co., Pittsburgh, Penn., was re-elected president at the annual directors' meeting of the National Slag Association. C. E. Ireland, Birmingham Slag Co., Birmingham, Ala., was re-elected vice-president, and H. J. Love, Cleveland, Ohio, was re-elected secretary-treasurer.

Another Endorsement of Proposed Public Works Conference

I HAVE NOTED with considerable interest your editorial comment in Rock Products of March 28 on the subject of a National Conference on Public Works Policies. I think very few people if any would take issue with your editorial comment above referred to or of the very appropriate proposition of a national conference to discuss the points as well as any others raised in your comment.

It is our opinion that public officials if they are to properly discharge their duties cannot afford, and at the same time have the public good in mind, to use methods which are and have been for a long time considered unfair and unjust in securing prices on any commodities purchased under their supervision which are below a fair cost to the producer plus a fair margin of profit.

It goes without saying that at a time when there is not sufficient demand for the supply that prices obtained will be low. Every producer is anxious to operate his plant at a fair capacity and the very existence of a lack of sufficient demand forces prices which carry only a fair or small or sometimes no margin of profit, therefore municipal, county, state or government officials, who are the purchasing agents of the people of their communities, are not properly discharging their duties if they contribute to practices in purchasing which are frowned upon by every honest individual business man, corporation or what not.

The great trouble with regard to the conference suggested would be the proper selection of representatives. Some executives of some companies are given to representing themselves to be the spokesmen for the whole industry and in so doing they present their own private views which are very often inaccurate, unjust and unjustified. Therefore, if such a conference were to consider the views of such an industry as the cement industry is, the representatives chosen should be chosen with such care that there would be assurance that the representatives *would* properly reflect the views of the entire industry and not of the individual who may set himself up as the spokesman for the industry but in reality be speaking for a company which he may be connected with solely.

The same thing, of course, would apply to all the industries which might be represented at such a conference.

There is little doubt that a conference of repesentatives who could speak for their industries, and who would have sufficient following so that those industries would benefit by the results of such a conference, could have untold benefits in shaping the policies of public works.

W. D. Cloos,
Vice-President and General Manager,
Edison Portland Cement Co.

* * * * *

I agree with you thoroughly that something should be done, but just what should be done I do not know, as I do not remember any such conditions as now exist. We certainly need a "Moses," but whether we would recognize him or not if he appeared is a question.

I fully agree with you that the fatalistic attitude of a good many producers is neither constructive nor desirable, and whether necessary or not, it seems inevitable. Whether your proposal is practicable or feasible I do not know, but it is an attempt to do something and is better than sitting still waiting for something to happen.

Thos. McCroskey,
Manager, American Limestone Co.

Pause and Read!

HERBERT N. CASSON, a British editor, penned this message to American business men:

"You are depressed. You think you are crippled. You are afraid of the future. You are full of fears.

"You have half the gold of the world and half the machinery and most of the automobiles and all the skyscrapers.

"You have the greatest home market in the world and the largest corporations that the world has ever seen.

"You are ruled more by ideas and less by tradition than any other people in the world. You have usually done what you thought you could do.

"There is now a golden opportunity for every man who has eyes to see it.

"Dollars are now being sold for thirty cents. Practically every security in the United States is now being sold at less than its value.

"The way to create a fortune is to buy from pessimists. Pay your money and take the risk.

"Frick started his career by buying coke ovens in the slump of 1873. Carnegie made $300,000,000 by buying steel plants in slumps.

"In five years from now most American business men will belong to the 'I-Wish-I-Had Club.'

"Then it will be too late to buy dollars for thirty cents. The opportunities will be gone.

"When a horse balks the balk is in his head, not in his legs. He moves on when he thinks he will."

National Ready Mixed Concrete Association Headquarters in Washington, D. C.

J. E. BURKE, Pittsburgh, Penn., president of the National Ready Mixed Concrete Association, has issued the following announcement:

"The board of directors of the National Ready Mixed Concrete Association wishes to announce that arrangements have been concluded with the National Sand and Gravel Association whereby the executive personnel of that organization will conduct the activities of the National Ready Mixed Concrete Association, in addition to their duties with the organization of the sand and gravel industry. It should be mentioned in this connection that although the executive personnel of the two associations is the same, the activities of the organization will be handled independently of each other.

"Effective April 1, the headquarters of our organization were transferred to the Munsey building, Washington, D. C. Stanton Walker will act as director of engineering, and V. P. Ahearn will handle the duties of the executive secretary.

"While the National Ready Mixed Concrete Association has been in existence for less than a year, it already includes within its membership a substantial number of ready mixed concrete companies, representing every part of the United States and Canada. The officers of the association feel that considerable progress has already been made in coordinating the interests of the ready mixed concrete industry, and they are confident that the accomplishments of the organization in the future will merit the support of all branches of the industry. Within a short time publications of our association will be available which deal with the manufacture and use of ready mixed concrete. Requests for these publications should be submitted to our Washington headquarters."

The officers and directors of the National Ready Mixed Concrete Association are: J. E. Burke, president, Pittsburgh, Penn.; Paul P. Bird, vice-president, Boston, Mass.; H. F. Thomson, vice-president, St. Louis, Mo.; R. B. Young, vice-president, Toronto, Ont., Canada; J. C. Eakin, secretary, Little Rock, Ark.; J. L. Shiely, treasurer, St. Paul, Minn.; Alexander Foster, Jr., Philadelphia, Penn.; Stanton Walker, director of engineering, Washington, D. C.; V. P. Ahearn, executive secretary, Washington.

Attract Movie Cameras

CLICKING CAMERAS recorded the prettiest river scene here in years when three towboats came around the bend from down the river sounding their whistles.

The three steamers lashed side and side were pushing a heavy fleet of sand and gravel boats and equipment up the river. The boats in the tow belong to the H. A. Carpenter Sand and Gravel Co., St. Marys, W. Va.—*Athens* (Ohio) *Messenger.*

Editorial Comment

Just What Can a Conference Accomplish?

Readers of the April 25 issue of ROCK PRODUCTS doubtless were interested in the letters of 24 prominent and representative producers of materials, largely used in public-works construction, as a reaction to our suggestion for a National Conference on Public Works Policies. The suggestion was made, it may be recalled, in an editorial in the March 28 issue, because government officials, who have been quite unanimous in proclaiming and recognizing the desirability of maintaining wage scales, might thus be persuaded to recognize the relation between the prices which they are largely responsible for setting on construction materials, and the wage scales which these prices are forcing producers to adopt.

Although a number of producers whole-heartedly endorsed the suggestion, only one mentioned the reason why the public-works construction materials industry quite logically may be made an example in meeting openly the problem of nearly all industry—because it is the one great industry that comes in *direct contact* with government officials, and one that government officials, by their purchasing power and policies, can in times like the present, actually make or break.

Objections to the proposed conference were (1) that it may not accomplish any immediate results; (2) would not be representative; (3) sentiment is not in favor of conferences; (4) no code can be drawn that will not have to be compromised; (5) if called by business interests would be regarded with suspicion, if by government interests would be motivated by political considerations; (6) can be handled better by local groups; (7) no attempt should be made to interrupt "deflation" of prices and wages; (8) politics are too strong a factor for anything to be accomplished; (9) fear that it would result in government price-fixing; (10) no code of principles would have binding power "back home," on account of local politics; (11) problem too complex to be solved by formula; (12) conference would result in nothing more than a debate.

The most important objections to a conference are doubtless political. So long as business and economic conditions are political capital of one party or another, there will be difficulty in conducting either business or government on an efficient basis; but we see no reason for ceasing to try. That such a conference can accomplish nothing of immediate value is obvious; that the situation is too complex to be solved by formula is equally obvious; that the conference might develop into a debate is quite possible.

Assuming it is desirable both in the interests of business and of the public to halt, if possible, the continued decline of wages and commodity prices, a method of assisting this objective is certainly open to discussion. Whether it could be best accomplished by a national conference or by local conferences is a matter of doubt. Secretary of Commerce R. P. Lamont, in his discussion of the suggestion said: "The spirit of fair play within the community should be brought out and made effective wherever the prices of materials are in danger through over-zealous public purchasing." Can this spirit of fair play best be developed by a national or local discussion?

Conferences such as that recently held in Texas of state highway officials and aggregate producers have done much to dispel mutual misunderstanding and distrust in matters pertaining to specifications for material and their interpretation. We could recall many instances to prove this, were it necessary. Any conference, on any subject of mutual interest, if it is intelligently conducted in a spirit of fair play and for the purpose of understanding and mutual helpfulness for the common good, results in something.

The good that might be accomplished would not have immediate results, nor probably be of very tangible value in any event; but it could hardly fail to be something of a factor in the restoration of general confidence in industry so badly needed now. Even if the conference became merely a debate, it would still have value in influencing public opinion—if conducted by able speakers.

Much could be done to overcome the opinion, now being widely spread by local newspapers, that the "high prices" of the past were the result of collusion and imposition on the public. This kind of publicity, and it is very prevalent at the present time, is going to be difficult to overcome when producers are able to restore prices to a profitable basis, and is likely to remain a permanent handicap in the future public relations of the industry. The sooner an effort is made to restore the confidence of the public in the fairness of producers, the easier will be the task. If a better way can be found, it should be adopted.

ROCK PRODUCTS and other industrial journals which know and understand something of the problems and difficulties of the particular industries they serve are indeed doing what they can, but the general public seldom sees such efforts, or would be much influenced by them if it did. But in a conference attended by public officials and producers, for a free and open discussion of problems vital to the public welfare, we believe both newspapers and public would be interested—perhaps the more so if there were a spirited debate.

Possibly the coming annual conference of the governors of the various states provides an opportunity. It seems probable if these governors were approached in the right way, they could be persuaded to devote a day or two of their conference to hearing the arguments of representatives of the construction industries as to why present prices are proving ruinous to wage earners and investors, and why it is to the public interest to consider all angles of public-works contracts. Under such auspices it seems certain the conference would receive adequate publicity, and wherever there is adequate publicity the truth is sure to be developed eventually.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[27]	4-20-31	95	100	
Alpha P. C. new com.[2]	5- 2-31	12	14	25c qu. Apr. 25
Alpha P. C. pfd.[2]	5- 2-31	115	120	1.75 qu. Mar. 14
Amalgamated Phosphate Co. 6's 1936[19]	5- 4-31	99	101	
American Aggregates com.[19]	5- 4-31	5	10	75c qu. Mar. 1
American Aggregates pfd.[19]	5- 4-31	68	75	1.75 qu. Apr. 1
American Aggr. 6's w.w.[19]	5- 4-31	65	75	
American Aggr. 6's ex. w.[19]	5- 4-31	62	72	
American Brick Co., sand-lime brick	5- 4-31	.....	7	25c qu. Feb. 1, '30
American Brick Co. pfd.	5- 4-31	52¾	57	50c qu. May 1, '30
Am. L. & S. 1st 7's[19]	5- 4-31	95	98	
American SilicaCorp. 6½'s[39]	5- 6-31	No market		
Arundel Corp. new com.	5- 5-31	38½	.....	75c qu. Apr. 1
Beaver P. C. 1st 7's[20]	4-30-31	90	95	
Bessemer L. & C. Cl. A[4]	5- 1-31	27	28½	75c qu. May 1
Bessemer L. & C. 1st 6½'s[4]	5- 1-31	85	88	
Bloomington Limestone 6's[27]	4-20-31	53½	55	
Boston S. & G. new com.[37]	5- 2-31	10	14	30c qu. Apr. 1
Boston S. & G. new 7% pfd.[37]	5- 2-31	40	44	87½c qu. Apr. 1
California Art Tile A	5- 1-31	.....	5½	43¾c qu. Mar. 31
California Art Tile B[40]	4-30-31	.....	3	20c qu. Mar. 31
Calaveras Cement com.	5- 1-31	.....	10	
Calaveras Cement 7% pfd.	5- 1-31	.....	78	1.75 qu. Apr. 15
Canada Cement com.	5- 5-31	12	12⅛	
Canada Cement pfd.	5- 5-31	93¼	94	1.62½ qu. Mar. 31
Canada Cement 5½'s[34]	5- 2-31	.....	101¼	
Canada Cr. St. Corp. bonds[42]	5- 2-31	89	93	
Certainteed Prod. com.	5- 5-31	4½	4⅞	
Certainteed Prod. pfd.	5- 5-31	23	25	1.75 qu. Jan. 1
Cleveland Quarries	5- 5-31	.....	60	75c qu. June 1
Columbia S. & G. pfd.	5- 4-31	93	96	
Consol. Cement 1st 6½'s, A[44]	5- 6-31	No market		
Consol. Cement notes, 1941[28]	5- 6-31	No market		
Consol. Cement pfd.[37]	4-20-31	50	60	
Consol. Oka S. & G. 6½'s[12] (Canada)	5- 2-31	100	101	
Consol. Rock Prod. com.[9]	4-30-31	75c	1	
Consol. Rock Prod. pfd.[9]	4-30-31	3½	4	43¾c qu. June1,'30
Consol. Rock Prod. units	5- 4-31	7	9	
Consol. S. & G. pfd. (Can.)	5- 5-31	70	74	1.75 qu. May 15
Construction Mat. com.	5- 2-31	6½	7	
Construction Mat. pfd.	5- 2-31	23	24	87½c qu. May 1
Consumers Rock & Gravel, 1st Mtg. 6's, 1948[35]	4-30-31	70	75	
Coosa P. C.1st 6's[27]	4-20-31	51	53	
Coplay Cem. Mfg. 1st 6's[33]	5- 2-31	95	.....	
Coplay Cem. Mfg. com.[33]	5- 2-31	5	7½	
Coplay Cem.Mfg. pfd.[33]	5- 2-31	25	40	
Dolese & Shepard	5- 5-31	49	54	$1 Apr. 1
Dufferin Pav. & Cr. Stone com.	5- 5-31	6	.....	
Dufferin Pav. & Cr. Stone pfd.	5- 5-31	71	75	1.75 Apr. 1
Edison P. C. com.[23]	5- 2-31	2	.....	
Edison P. C. pfd.[32]	5- 2-31	5	.....	
Federal P. C. 6½'s, 1941[19]	5- 4-31	95	100	
Giant P. C. com.[24]	5- 2-31	1½	3½	
Giant P. C. pfd.[24]	5- 2-31	6	12	1.75 s.-a. Dec. 15
Gyp. Lime & Alabastine, Ltd.	5- 5-31	8⅝	8⅞	20c qu. Apr. 1
Hermitage Cement com.[11]	5- 2-31	15	25	
Hermitage Cement pfd.[11]	5- 2-31	75	80	
Ideal Cement, new com.[29]	5- 2-31	35	45	75c qu. Mar. 31
Ideal Cement 5's, 1943[29]	5- 2-31	98	100	
Indiana Limestone com.[27]	4-20-31	3	6	
Indiana Limestone 6's	5- 5-31	42 act. sale		
International Cem. com.	5- 5-31	36½	37½	$1 qu. Mar. 31
International Cem. bonds 5's	5- 5-31	87½	88	Semi-ann. int.
Iron City S. & G. bonds 6's[36]	5- 2-31	85	.....	
Kellev Is. L. & T. new stock	5- 5-31	.....	30	62½c qu. Apr. 1
Ky. Cons. St. V. T. C.[38]	5- 2-31	6	8	
Ky. Cons. Stone 6½'s[38]	5- 2-31	80	85	
Ky. Cons. Stone com.[38]	5- 2-31	6	8	
Ky. Cons. Stone pfd.	5- 5-31	75	85	1.75 qu. Feb. 1
Ky. Cons. Stone, trustee ctfs.	5- 2-31	75	88	
Ky. Rock Asphalt com.[11]	5- 2-31	5	6	40c qu. Oct. 1, '30
Ky. Rock Asphalt pfd.[11]	5- 2-31	70	75	1.75 qu. Mar. 1
Ky. Rock Asphalt 6½'s[11]	5- 2-31	98	100	
Lawrence P. C.[2]	5- 2-31	50	56	$1 qu. Mar. 31
Lawrence P. C. 5½'s, 1942[2]	5- 2-31	86	88	
Lehigh P. C.	5- 5-31	12	13	25c qu. May 1
Lehigh P. C. pfd.	5- 5-31	97¼	97¾	1.75 qu. Apr. 1
Louisville Cement[7]	5- 1-31	175	225	
Lyman-Richey 1st 6's, 1932[13]	5- 1-31	97	.....	
Lyman-Richey 1st 6's, 1935[13]	5- 1-31	95	.....	
Marblehead Lime 6's[34]	5- 1-31	No market		
Marbelite Corp. com. (cement products)	5- 2-31	1	.....	
Marbelite Corp. pfd.	4-17-31	4	.....	50c qu. Oct. 10, '30
Material Service Corp.	5- 2-31	22	23½	50c qu. June 1
McCrady-Rodgers 7% pfd.[22]	5- 1-31	45	48	87½c qu. Mar. 30
McCrady-Rodgers com.[22]	5- 1-31	15	21½	75c Jan. 26
Medusa Portland Cement	5- 5-31	.....	59	75c qu. Apr. 1
Michigan L. & C. com.[6]	5- 2-31	45	.....	
Missouri P. C.	5- 5-31	21	23	50c qu. Apr. 30
Monolith Portland Midwest[9]	4-30-31	1	2	
Monolith P. C. com.[9]	4-30-31	2	3	40c s.-a. Jan. 1
Monolith P. C. pfd.[9]	4-30-31	3	4	40c s.-a. Jan. 1
Monolith P. C. units[9]	4-30-31	7	9	
Monolith P. C. 1st Mtg. 6's[9]	4-30-31	75	80	
National Cem. (Can.) 1st 7's[34]	5- 2-31	99½	.....	
National Gypsum A com.	5- 5-31	4¾	5¼	
National Gypsum pfd.	5- 5-31	46	.....	$1 Apr. 1
Nazareth Cement com.[25]	5- 2-31	14	.....	
Nazareth Cement pfd.[25]	5- 2-31	95	.....	
Newaygo P. C. 1st 6½'s[27]	4-20-31	101	.....	
New England Lime 1st 6's[10]	5- 4-31	.....	60	
N. Y. Trap Rock 1st 6's	5- 5-31	100¼ act. sale		
N. Y. Trap Rock 7% pfd.[30]	5- 5-31	95	.....	1.75 Apr. 1
North Amer. Cem. 1st 6½'s	5- 2-31	41	44	
North Amer. Cem. com[27]	4-20-31	50c	2	
North Amer. Cem. 7% pfd.[27]	4-20-31	11	22	
North Shore Mat. 1st 5's[15]	5- 6-31	90	.....	
Northwestern States P. C.[31]	4-18-31	95	.....	$2 Apr. 1
Ohio River Sand com.	5- 5-31	.....	14	
Ohio River Sand 7% pfd.	5- 5-31	.....	98	
Ohio River S. & G. 6's[16]	5- 2-31	85	90	
Oregon P. C. com.[9]	4-30-31	9	13	
Oregon P. C. pfd.[9]	4-30-31	80	90	
Pacific CoastAggr. com.[40]	4-30-31	.....	1½	
Pacific Coast Aggregates pfd.	5- 4-31	2½	3½	
Pacific Coast Cement 6's[5]	4-30-31	64	74	
Pacific P. C. com.	5- 1-31	12	.....	
Pacific P. C. pfd.	5- 1-31	.....	68	1.62½ qu. Apr. 4
Pacific P. C. 6's	5- 1-31	99½	100¼	
Peerless Cement com.[1]	5- 1-31	2	3	
Peerless Cement pfd.[1]	5- 1-31	55	65	1.75 qu. Apr. 1
Penn.-Dixie Cement com.	5- 5-31	3	3½	
Penn.-Dixie Cement pfd.	5- 5-31	14⅛	16½	
Penn.-Dixie Cement 6's	5- 5-31	60½ act. sale		
Penn. Glass Sand Corp. 6's	4- 8-31	100½	103	
Penn. Glass Sand Corp. pfd.	4- 8-31	90	.....	1.75 qu. Apr. 1
Petoskey P. C.	5- 5-31	6½	7½	15c qu. Apr. 1
Port Stockton Cem. com.[9]	4-30-31	No market		
Riverside Cement com.	5- 1-31	.....	14	
Riverside Cement pfd.[20]	4-30-31	65	70	1.50 qu. May 1
Riverside Cement, A[20]	4-30-31	10	15	15c qu. Feb. 1
Riverside Cement, B[20]	4-30-31	1	2	
Roquemore Gravel 6½'s[17]	5- 2-31	98	100	
Sandusky Cement 6½'s, 1931-37[19]	5- 4-31	90	100	
Santa Cruz P. C. com.	5- 1-31	84	.....	$1 qu. Apr. 1
Schumacher Wallboard com.	5- 1-31	8⅛	10	25c qu. Mar. 27
Schumacher Wallboard pfd.	5- 1-31	.....	21	50c qu. May 15
Southwestern P. C. units[35]	4-30-31	240	.....	
Standard Paving & Mat. (Canada) com.	5- 5-31	11½	12	50c qu. May 15
Standard Paving & Mat. pfd.	5- 5-31	.....	77	1.75 qu. May 15
Superior P. C., A	5- 1-31	32¾	36½	27½c mo. May 1
Superior P. C., B	5- 1-31	12½	13	25c qu. Mar. 20
Trinity P. C.units[31]	4-18-31	105	.....	
Trinity P. C. com.[31]	4-18-31	17½	30	
Trinity P. C. pfd.[27]	4-20-31	109	112	
U. S. Gypsum com.	5- 5-31	40½	41½	40c qu. Mar. 31
U. S. Gypsum pfd.	5- 5-31	128⅝	130½	1.75 qu. Mar. 31
Wabash P. C.[21]	4-20-31	.....	22	
Warner Co. com.[16]	5- 2-31	26	29	50c qu. Apr. 15
Warner Co. 1st 7% pfd.[16]	5- 2-31	94	96	1.75 Apr. 1
Warner Co. 1st 6's w. w.[8]	5- 7-31	93	93¾	
Whitehall Cem. Mfg. com.[30]	5- 5-31	80	.....	
Whitehall Cem. Mfg. pfd.[30]	5- 5-31	50	.....	
Wisconsin L. & C. 1st 6's[15]	5- 6-31	90	.....	
Wolverine P. C. com.	5- 5-31	2¼	4	15c qu. Nov. 15
Yosemite P. C., A com.[9]	4-30-31	2	3	

Quotations by: [1]Watling Lerchen & Hayes Co., Detroit, Mich. [2]Bristol & Willett, New York. [3]Rogers, Tracy Co., Chicago. [4]Butler, Beadling & Co., Youngstown, Ohio. [5]Smith, Camp & Co., San Francisco, Calif. [6]Frederic H. Hatch & Co., New York. [7]J. J. B. Hilliard & Son, Louisville, Ky. [8]Dillon, Read & Co., Chicago, Ill. [9]A. E. White Co., San Francisco, Calif. [10]Lee Higginson & Co., Boston and Chicago. [11]J. W. Jakes & Co., Nashville, Tenn. [12]James Richardson & Sons, Ltd., Winnipeg, Man. [13]Stern Bros. & Co., Kansas City, Mo. [14]First Wisconsin Co., Milwaukee, Wis. [15]Central Trust Co. of Illinois. [16]J. S. Wilson, Jr., Co., Baltimore, Md. [17]Citizens Southern Co., Savannah, Ga. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hewitt, Ladin & Co., New York. [20]Tucker, Hunter, Dulin & Co., San Francisco, Calif. [21]Baker, Simonds & Co., Inc., Detroit, Mich. [22]Peoples-Pittsburgh Trust Co., Pittsburgh, Penn. [23]A. B. Leach & Co., Inc., Chicago, Ill. [24]Richards & Co., Philadelphia, Penn. [25]Hincks Bros. & Co., Bridgeport, Conn. [26]Bank of Republic, Chicago, Ill. [27]National City Co., Chicago, Ill. [28]Chicago Trust Co., Chicago, Ill. [29]Boettcher & Co., Denver, Colo. [30]Hanson and Hanson, New York. [31]S. F. Holzinger & Co., Milwaukee, Wis. [32]Tobey and Kirk, New York. [33]Steiner, Rouse and Co., New York. [34]Jones, Heward & Co., Montreal, Que. [35]Tenney, Williams & Co., Los Angeles, Calif. [36]Stein Bros. & Boyce, Baltimore, Md. [37]Wise, Hobbs & Arnold, Boston. [38]E. W. Hays & Co., Louisville, Ky. [39]Blythe Witter & Co., Chicago, Ill. [40]Martin Judge Co., San Francisco, Calif. [41]Hemphill, Noyes & Co., New York City. [42]Nesbitt, Thomas & Co., Montreal. [43]Foreman State-National Bank, Chicago. [44]E. H. Rollins, Chicago.

Consolidated Cement Corp. Annual Statement

AS THE RESULT of generally depressed industrial conditions, the year 1930 recorded a continuance of the decline in consumption of cement in the United States which started in 1929, according to the annual report of John L. Senior, president of the Consolidated Cement Corp., Chicago, Ill. Consumption in 1930 was approximately 6½% less than in 1929.

The Consolidated Cement Corp.'s 1930 shipments amounted to 1,735,236 bbl., which is about 10% under 1929, which with less favorable prices accounts for a loss in net sales of $330,325.98.

Through constant attention to the reduction of cost, notwithstanding reduced output, the corporation succeeded in maintaining a manufacturing cost at approximately the 1929 level.

The summarized profit and loss statement for the year 1930 is given below:

Net sales	$2,406,513.33
Other income (net)	11,105.46
Gross income	$2,417,618.79
Cost of cement sold, selling and administrative expense (exclusive of depreciation and depletion)	*2,034,568.17
Net earnings	$ 383,050.62
Depreciation and depletion	200,815.58
Balance available for interest, amortization, federal taxes, etc.	$ 182,235.04
Annual interest requirements on $3,617,300 first mortgage 6½% bonds	$ 235,124.50
Annual interest requirements on $1,001,000.00 sinking fund 6½% convertible gold notes	65,065.00

*Includes $185,429.18 charged to maintenance.

CONDENSED BALANCE SHEET OF THE CONSOLIDATED CEMENT CORP.
(at December 31, 1930)

ASSETS

Cash, including temporary investment of surplus cash funds	$ 463,359.14
Accounts and notes receivable (net)	216,775.83
Inventories of cement, materials and supplies	473,764.96
Inventories of cloth and paper sacks	173,763.55
Current assets	$1,327,663.48
Prepaid expenses	57,516.24
Investments and other sundry assets	111,176.20
Plants, properties and quarry lands—at appraised sound values, as determined by American Appraisal Co., depreciated to date of acquisition plus subsequent additions at cost, subject to reserve for depreciation per contra	6,475,102.86
Unamortized bond and note discount and expense, organization expense, etc.	300,834.98
Good will	1.00
	$8,272,294.76

LIABILITIES AND NET WORTH

Accounts payable, accrued salaries, local taxes, interest, etc., and reserve for federal taxes	$ 171,001.37
Sinking fund 6½% convertible gold notes due March 1, 1931, less notes held for retirement	1,001,000.00
First mortgage 6½% gold bonds—Series A—due March 1, 1941, less amount held by trustee for cancellation	3,617,300.00
Reserve for depreciation and depletion subsequent to date of acquirement of properties	990,389.11
Reserve for contingencies and insurance	108,522.57
7% cumulative preferred stock	1,392,800.00
No par value common stock—100,000 shares issued and outstanding—declared value	100,950.00
Capital surplus	694,899.86
Earned surplus	195,431.85
	$8,272,294.76

For comparative purposes the following statement is reported for 1929 and 1930:

CONSOLIDATED INCOME ACCOUNT, YEARS ENDED DECEMBER 31

	1930	1929
Net sales	$2,406,513	$2,736,839
*Operating expenses	2,034,568	2,246,203
Depreciation and depletion	200,815	194,266
Net operating revenue	171,130	296,370
Other income	11,105	25,373
Total income	182,235	321.743
Fixed charges	300,189	312,657
Net income	(d)$117,954	$9,086
Earned per share, preferred	nil	$0.65

Based on 13,928 preferred shares.
*Includes maintenance charges of $185,429 in 1930 and $172,774 in 1929.

BALANCE SHEET, AS OF DECEMBER 31

ASSETS

	1930	1929
Plants and equipment	$6,475,103	$6,415,522
Good will	1	1
Current assets:		
Accounts and notes receivable (net)	216,776	330,369
Cash	463,359	562,806
Inventories	647,528	667,215
Investments, etc.	111,176	99,703
Deferred charges	358,351	380,891
Total	$8,272,294	$8,456,507

LIABILITIES

Preferred stock	$1,392,800	$1,392,800
*Common stock	100,950	100,950
Bonded debt	3,617,300	4,810,100
Current liabilities:		
Accounts payable, etc.	171,001	280,470
Funded debt maturity	1,001,000	.....
Reserve for depreciation and depletion	990,389	801,333
Reserve for contingencies	108,523	75,404
Capital surplus	694,900	727,200
Earned surplus	195,432	268,250
Total	$8,272,294	$8,456,507
Current assets	$1,327,663	$1,560,390
Current liabilities	1,172,001	280,470
Working capital	$ 155,662	$1,279,920

*Represented by 100,000 no par shares.

Keystone Sand and Supply Co.

THE Keystone Sand and Supply Co., Pittsburgh, Penn., reports for 1930 net earnings, after depreciation but before interest and federal taxes, of $365,914.

BALANCE SHEET, AS OF DECEMBER 31

ASSETS

	*1930	†1929
Land, plants and equipment	$3,175,604	$2,357,901
Good will	26,200	.....
Investments	450,478	410,661
Current assets:		
Cash	112,342	199,101
Accounts receivable	166,778	275,231
Notes receivable	47,021	76,910
Inventories	84,109	91,061
Deferred charges	60,334	64,029
Total	$4,122,867	$3,474,894

LIABILITIES

Capital stock	$1,250,000	$1,250,000
Funded debt	1,146,000	1,200,000
Current liabilities:		
Bills payable	1,900	.....
Accounts payable	51,151	76,148
Accruals	34,839	35,176
Dividends payable	.....	37,500
Reserve for taxes and contingencies	36,384	64,940
‡Surplus	1,602,593	811,130
Total	$4,122,867	$3,474,894
Current assets	$ 410,251	$ 642,303
Current liabilities	124,474	213,764
Working capital	$ 285,977	$ 428,539

*Includes Inland Rivers Wharf Co. and Eastern Ohio Sand and Supply Co. †Includes Inland Rivers Wharf Co. ‡Includes $681,549 appreciation from appraisal of fixed assets.

Pacific Coast Aggregates, Inc.

SUPPLEMENTING the earnings statement of the Pacific Coast Aggregates, Inc., San Francisco, Calif., reported on page 81 of ROCK PRODUCTS, April 25, 1931, the following balance sheet of the corporation, as of December 31, 1930, is reported:

ASSETS

	1930	1929
*Property account	$18,361,354	$18,653,003
Contracts, etc.	.....	1
Investments	428,961	42,739
Current assets:		
Cash		731,263
Accounts receivable, etc.	1,074,650	545,878
Inventories		552,023
Deferred charges	718,488	749,391
Total	$20,583,452	$21,274,298

LIABILITIES

Capital stock	$15,048,468	
Surplus	(d)469,784	$14,908,259
Bonded debt	5,452,000	5,500,000
Minority interest	.....	244,627
Current liabilities:		
Accounts payable, etc.	323,076	586,926
Deferred income	61,650	3,363
Reserves	168,042	31,123
Total	$20,583,452	$21,274,298
Current assets	$ 1,074,650	$ 1,829,164
Current liabilities	323,076	586,926
Working capital	$ 751,574	$ 1,242,238

*After depreciation and depletion: 1930, $1,621,994.

Recent Dividends Announced

Cleveland Quarries (qu.)	0.75, June 1
Consolidated Sand and Gravel pfd. (Can.) (qu.)	1.75, May 15
Material Service (qu.)	0.50, June 1
Missouri Portland Cem. (qu.)	0.50, Apr. 30
Standard Paving and Materials (Can.) com. (qu.)	0.50, May 15
Standard Paving and Material (Can.) pfd. (qu.)	1.75, May 15

International Cement Report

THE consolidated profit and loss statement of the International Cement Corp. for the first quarter of 1931 is as follows:

	First quarter 1931
Gross sales	$6,111,424.51
Less: Packages, discounts and allowances	1,178,498.86
Net sales	$4,932,925.65
Manufacturing cost excluding depreciation	$2,644,879.36
Depreciation	467,625.38
	$3,112,504.74
Manufacturing profit	$1,820,420.91
Shipping, selling and administrative expenses	1,055,370.06
Net profit	$ 765,050.85
Less interest, etc.	193,135.71
	$ 571,915.14
Reserves for federal taxes and contingencies	161,005.86
Net to surplus	$ 410,909.28

Earnings of the domestic subsidiaries were greater than for the first quarter of 1930.

The net income of $410,909 after depreciation, federal taxes, etc., is equivalent to 65c. a share on 636,085 shares of no-par common stock. This compares with $841,480 or $1.34 a share on 628,883 shares in first quarter of 1930.

INCOME ACCOUNT OF INTERNATIONAL CEMENT CORP.

	1931	1930	1929	1928
Gross sales	$6,111,424	$7,239,744	$7,491,036	$6,719,938
Expenses, etc.	4,878,748	5,506,287	5,630,821	5,020,808
Depreciation	467,626	491,037	446,369	400,048
Net	$ 765,050	$1,242,420	$1,413,846	$1,299,082
Interest, taxes, etc.	354,141	400,940	396,227	231,154
Net income	$ 410,909	$ 841,480	$1,017,619	$1,067,928

Traffic and Transportation

Car Loadings of Sand and Gravel, Stone and Limestone Flux

THE following are the weekly loadings of sand and gravel, crushed stone and limestone flux (by railroad districts) as reported by the Car Service Division, American Railway Association, Washington, D. C.:

CAR LOADINGS OF SAND, GRAVEL, STONE AND LIMESTONE FLUX

District	Limestone Flux Week ended April 4	Limestone Flux Week ended April 11	Sand, Stone and Gravel Week ended April 4	Sand, Stone and Gravel Week ended April 11
Eastern	1,646	1,721	1,543	2,820
Allegheny	1,381	1,697	2,244	2,898
Pocahontas	272	341	700	805
Southern	665	641	6,081	7,247
Northwestern	618	823	1,579	2,315
Central Western	440	387	4,380	5,642
Southwestern	234	98	4,372	5,695
Total	5,256	5,708	20,899	27,422

COMPARATIVE TOTAL LOADINGS, BY DISTRICTS, 1930 AND 1931

District	Limestone Flux 1930 Period to date April 12	Limestone Flux 1931 Period to date April 11	Sand, Stone and Gravel 1930 Period to date April 12	Sand, Stone and Gravel 1931 Period to date April 11
Eastern	32,795	19,685	38,484	19,185
Allegheny	33,962	22,423	44,036	23,781
Pocahontas	3,485	1,957	9,847	7,909
Southern	9,254	8,288	93,492	86,561
Northwestern	9,012	6,139	20,768	15,174
Central Western	7,054	5,893	90,754	52,265
Southwestern	5,201	3,511	68,501	53,164
Total	100,763	67,896	365,882	258,039

COMPARATIVE TOTAL LOADINGS, 1930 AND 1931

	1930	1931
Limestone flux	***100,763***	***67,896***
Sand, stone, gravel	***365,882***	***258,039***

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week of May 2:

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

22453. **Stone, crushed or broken; grout, granite or stone; rubble, stone** (See Note 3).

From	Group
Pratt, N. H.	A
South Milford, N. H.	A
West Chelmsford, Mass.	B

Group A*

To	Pres.	Prop.
Ardley, N. Y.	$4.80	$2.80
Bryn Mawr Park, N. Y.	4.90	2.80
Elmsford, N. Y.	4.80	2.80
Mt. Vernon, N. Y.	4.80	2.80
Scarsdale, N. Y.	4.80	2.80
Tuckahoe, N. Y.	4.80	2.80

Group B*

To	Pres.	Prop.
Ardley, N. Y.	$4.30	$2.60
Bryn Mawr Park, N. Y.	4.40	2.60
Elmsford, N. Y.	4.30	2.60
Mt. Vernon, N. Y.	4.30	2.60
Scarsdale, N. Y.	4.30	2.60
Tuckahoe, N. Y.	4.30	2.60

*Rates per ton of 2000 lb.

Reason—To establish commodity rates comparable with those now published on this material.

22506. **Dolomite or fluxing stone,** carloads, minimum weight 25 gross tons of 2240 lb., from Cheshire, Farnams, North Adams, Renfrew, Richmond, State Line and Zylonite, Mass. In cents per gross ton.

To (representative points)	Pres.	Prop.
State Line, Mass.	7½	117
Pittsfield, Mass.	5½	112
Westfield, Mass.	*151	*134
Springfield, Mass.	151	151
Webster, Mass.	11	173

*Including N. Y. N. H. & H. R. R. switching charges at Westfield, Mass., and N. Y. N. H. & H. R. R. and B. & M. R. R. switching charges at Worcester, Mass., as per tariffs lawfully on file with the Interstate Commerce Commission and Massachusetts Department of Public Utilities.

Reason—To establish rates comparable with those applied by competing carrier for similar distances.

22523. **Sand, building, common or run of bank** (See Note 2), from Montowese and Northford, Conn., to Stamford, Conn. Present rate, 13½c; proposed, 65c per net ton. Reason—To meet competitive conditions.

22532. **Common sand, run of bank gravel and screened or crushed gravel,** minimum weight 50 tons of 2000 lb. (100,000 lb.), from Scotia, N. Y., to Saratoga Springs, N. Y. Present rate, common sand and run of bank gravel, 70c; screened or crushed gravel, 80c per net ton. Proposed, common sand and run of bank gravel, 62c; screened or crushed gravel, 70c. Reason—To meet motor truck competition.

22552. **Screened gravel** (See Note 3), from North Wilbraham, Mass., to various points on B. & A. R. R., representative points below. Per ton of 2000 lb.

To	Prop.	Pres.
Boston, Mass., to Cambridgeport, Mass., inclusive	$1.10	$1.20
Auburndale, Mass.	1.10	1.15
Westboro, Mass.	.90	1.05
Charlton, Mass.	.90	.95

Reason—To equalize rates from shipping points on road building material.

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

Note 4—Reason—Proposed rates are comparable with rates on like commodities for like distances, services and conditions.

TRUNK LINE ASSOCIATION DOCKET

26647. To add Exton, Penn., as point of origin to Reading Co. tariffs I. C. C. Nos. 339, 503, 506, 775, 797, 817, 864, 875, 882, 962, 1006, 1018, 1024 and 1037, applying on **stone, rough, building, fluxing, dolomite and limestone,** with minimum carload weight as now provided for in above tariffs to points on the Baltimore & Ohio Railroad, Central Railroad of New Jersey, Chestnut Ridge Railway, Delaware & Hudson Railroad, Delaware, Lackawanna & Western Railroad, Erie Railroad, Lehigh Valley Railroad, Lehigh & Hudson River Railway, Morristown & Erie Railroad, Fonda, Johnstown & Gloversville Railroad, and Staten Island Rapid Transit Railway, taking same rates and minimum carload weights as applicable from Mill Lane, Penn. Reason—Providing same rates as applicable from contiguous shipping points.

26649. **Stone, crushed or quarry broken,** carloads (See Note 2), from Jamesville and Rock Cut, N. Y., to Crocketts, N. Y., $1 per net ton. (Present rate $1.10 per net ton.) Rate to expire December 1, 1931. Reason—Rate comparable with rates involving like hauls.

26251. **Ground limestone,** carloads, minimum weight 50,000 lb., from Alba-Marl Lime Co., W. Va., Buckeystown, Md., Capon Road, Va., Cedar Creek, Va., Charles Town, W. Va., Engle, W. Va., Frederick, Md., Grove, Md., Keller, Md., Martinsburg, W. Va., Millville, W. Va., Natural Lime-Marl Co.'s Siding, W. Va., Security, Md., Stephens City, Va., Strasburg, Va., Strasburg Jct., Va., Vaucluse, Va., Oranda, Va., to stations Ray Brook to Lake Placid, N. Y., inclusive, 31½c per 100 lb.

26159. **Sand, engine, molding and blast,** carloads (See Note 2), from Hancock, Md., and Round Top, Md., to Sheffield, Penn., $2.25 per net ton.

26426. (A) **Building lime,** carloads, minimum weight 30,000 lb.; (B) **Agricultural land, chemical, gas or glass lime,** carloads, minimum weight 30,000 lb., and **ground limestone,** carloads, minimum weight 50,000 lb., from Alba-Marl Lime Co., W. Va., Buckeystown, Md., Capon Road, Va., Cedar Creek, Va., Charles Town, W. Va., Engle, W. Va., Frederick, Md., Grove, Md., Keller, Md., Martinsburg, W. Va., Millville, W. Va., Natural Lime-Marl Co.'s Siding, W. Va., Security, Md., Stephens City, Va., Strasburg, Va., Strasburg Jct., Va., Vaucluse, Va., Oranda, Va., Annville, Penn., Bridgeport, Penn., Brownstone, Penn., Cedar Hollow, Penn., Cold Point, Penn., Corsons, Penn., Donaghmore, Penn., Exton, Penn., Howellville, Penn., Hummelstown, Penn., Lancaster, Penn., Leesport, Penn., Lebanon, Penn., Mill Lane, Penn., Myerstown, Penn., Palmyra, Penn., Paxtang, Penn., Plymouth Meeting, Penn., Shainline, Penn., Swatara, Penn., Swedeland, Penn., Williams, Penn., to Alton to Liverpool, N. Y., inclusive, (A) 17c and (B) 16c per 100 lb.

26654. **Sand,** in open-top cars, carloads (See Note 2), from Tatesville, Penn., to Altoona, Penn., $1.10 per net ton. Present rate, $1.40. Reason—Proposed rate is comparable with rate from Brumbaugh, Penn., to Morrison Cove Jct., Mifflin and Roaring Springs, Penn.

26659. To cancel commodity rates applying on **unburned, ground limestone,** carloads, minimum weight 50,000 lb., from Manlius, N. Y., to points on the N. Y. C. and W. S. R. R.'s published in Item 2960 of the West Shore Tariff I. C. C. W. S. No. 5957. Class rates to apply. Reason—Investigation develops no traffic has moved for some time nor is there prospects for future shipments, therefore rates are obsolete.

26668. **Crushed stone,** carloads (See Note 2), from Hendler, Penn., to Nicholson, Penn., $1.10 per net ton. Present rate, $1.25. (See Note 4.)

26669. **Crushed stone,** carloads (See Note 2), from Philadelphia, Penn., to Ocean City, N. J., $1.25 per net ton. Present rate, $1.40. (See Note 4.)

26670. **Crushed stone,** carloads (See Note 2), from Philadelphia, Penn., to Stone Harbor, N. J., $1.15 per net ton. Present rate, $1.40. (See Note 4.)

26679. **Trap rock, mine rock, broken stone, crushed stone and stone screenings,** carloads (See Note 2), from Millington, N. J., to points in Pennsylvania (rates in cents per ton of 2000 lb.):

To	Prop.	To	Prop.
East Stroudsburg	100	Mountain Home	110
or		Mt. Pocono	110
Stroudsburg	100	Pocono Summit	110
Analomink	100	Tobyanna	110
Henryville	100	Gouldsboro	120
Cresco	110	(See Note 4.)	

26680. **Stone, natural** (other than bituminous asphalt rock), **crushed, coated with oil, tar or asphaltum,** carloads (See Note 2), from Green Island, N. Y., to stations on the N. Y. C. R. R. and West Shore R. R., Cohoes, Schenectady, Little Falls, Salisbury Centre, Utica, Syracuse, Albany, Hudson, Poughkeepsie, Yonkers, Humaston, Remsen, Kast Bridge, Otter Lake, Carter, Glenmont, Ravena, Newburgh, Tappan, Weehawken, Jersey City, South Bethlehem, South Amsterdam, Mohawk, Chittenango, N. Y., and various. Rates ranging from 75c to $1.80 per net ton. Reason—Proposed rates are comparable with rates from South Bethlehem, N. Y.

26681. **Crushed stone, coated with oil, tar or asphaltum,** carloads (See Note 2), from Bound Brook, N. J., to P. R. R. points, Copper Hill, Milford, Kent, Trenton, Lawrence, Princeton, New Brunswick, Rahway, Waverly, N. J., and points in this district. Rates ranging from $1.05 to $1.45 per net ton. (See Note 4.)

26685. **Crushed stone,** carloads (See Note 2), from Hendler, Penn., to Retreat, Penn., $1 per net ton. Present rate $1.25 per net ton. (See Note 4.)

26687. Cancel rate of $1 per net ton on **sand, common or building** (not blast, engine, fire, foundry, glass, molding or silica), carloads, **and gravel,** carloads (See Note 2), from Fultonville, N. Y., to Little Falls, N. Y. Sixth class rate to apply. Reason—Investigation develops that no traffic has moved for some time nor are there prospects for future shipments, therefore rate is obsolete.

26695. **Sand** (other than blast, engine, foundry, glass, molding, quartz, silica or silex), **gravel and crushed stone,** carloads (See Note 2), from South Edmeston, N. Y., to D. & H. R. R. stations, Bainbridge Tunnel, Binghamton, Windsor, N. Y., Lanesboro, Wilkes-Barre, Penn., Unadilla, Cobleskill, Altamont, Albany, Cooperstown, N. Y., and various. Rates ranging from $1.25 to $1.95 per net

ton. Reason—Proposed rates are comparable with rates from Oriskany Falls, N. Y.

26697. **Crushed stone,** carloads (See Note 2), from Birdsboro, Reading, Wernersville, Myerstown and Annville, Penn., to points on the Reading company, Mohrsville, Gibraltar, Rutherford, Steelton, Allentown, Catasauqua, Cold Spring, Rockville, Exmoor, Lykens, Slatington, Lurgan, Shamokin, Otto, Herndon, Quakake, Gettysburg, Birdsboro, Tuckerton, Hamburg, Pottsville (12th St.), Penn., and various. Rates ranging from 60c to $1.60 per net ton. (See Note 4.)

26698. **Ground limestone,** carloads, minimum weight 50,000 lb., from Grove, Frederick, Martinsburg, Cedar Creek, Strasburg Jct., Charles Town districts to Bellefonte Central Railroad and Pennsylvania Railroad stations, Coleville, Hammer's Mill, Tyrone, Johnstown, Bessemer, Scottdale, Fairchance, Pittsburgh South Side, Clairton, Monongahela City, Donora, Vandergrift, Mifflinsburg, Clermont, Johnsonburg, Erie, South Oil City, Mill Run and various. Rates ranging from 11c to 15½c per 100 lb. Reason—Proposed rates are comparable with rates from Bellefonte, Ashcom, Penn., etc.

M-1738. **Crushed stone,** carloads (See Note 2), from West Paterson, N. J., to Secaucus, N. J., 50c per net ton. Rate to expire December 31, 1931. Reason—To meet motor truck and water competition.

26706. Cancel present commodity rates on **stone, natural** (other than bituminous asphalt rock), **crushed,** N. O. I. B. N., carloads (See Note 2), as follows:

From Aqueduct, N. Y., to points on the New York Central R. R. as shown in Item 90 of Tariff I. C. C. N. Y. C. No. 15402.

From Schenectady, N. Y., to Karner, N. Y., as shown in Item 95 of Tariff I. C. C. N. Y. C. No. 15402.

From Amsterdam, N. Y., to South Amsterdam, N. Y., as shown in Item 100 of Tariff I. C. C. N. Y. C. 15402.

From Palatine Bridge, N. Y., to points on the New York Central R. R. and West Shore R. R. as shown in Items 105 to 135, inclusive, of Tariff I. C. C. N. Y. C. No. 15402 and I. C. C. W. S. No. 5983.

From Canajoharie, N. Y., to points on the New York Central R. R. and West Shore R. R. as shown in Items 1755 to 1800, inclusive, of Tariff I. C. C. N. Y. C. No. 15402 and I. C. C. W. S. No. 5983.

Classification basis to apply.

Reason—Investigation develops no traffic has moved for some time nor are there prospects for future shipments, therefore rates are obsolete.

26710. **Crushed stone and screenings,** carloads (See Note 2), from Water Street, Penn., to Huntingdon, Penn., 60c per net ton. Present rate, 80c. Reason—Proposed rate is comparable with rate from Union Furnace, Penn.

26731. **Sand** (other than blast, engine, foundry, glass, loam, molding or silica), **and gravel,** C. L., (See Note 2), from Cumberland, Md., to points in West Virginia.

To	Prop.	To	Prop.
Marion	130	Mattingly	130
Towson	130	Irona	130
Jessop	130	Snider	130
Mountain View	130	Kingwood Jct.	130
Howesville	130	Kingwood	130

Rates in cents per 2000 lb.

Reason—Proposed rates are comparable with rates from Sturgisson, W. Va.

26742. **Crushed stone,** carloads (See Note 2), from Jamesville and Rock Cut, N. Y., to Rushville, N. Y., $1.45 per net ton; present rate $1.60. (See Note 4.)

26745. **Stone, natural** (other than bituminous asphalt rock), **crushed,** carloads (See Note 2), from Oaks Corners, N. Y., to Horseheads, N. Y., $1.20, and Elmira, N. Y., $1.25 per net ton. (See Note 4.)

26748. **Stone, natural** (other than bituminous asphalt rock), **crushed,** carloads (See Note 2), from Prospect Jct., N. Y., to Lyons Falls, N. Y., 75c per net ton. (To expire November 1, 1931.) (See Note 4.)

26756. **Sand and gravel,** carloads (See Note 2), from Richmond and Twohy Siding, Va., to Backbone, Jerry's Run and Alleghany, Va., $1.57 per net ton. (Present rate, $1.64.) Reason—Proposed rate is comparable with rates from Massaponax, Va.

26760. **Stone, natural** (other than bituminous asphalt rock), **crushed, coated with oil, tar or asphaltum,** carloads (See Note 2), from South Amsterdam, N. Y., to points in New York (rates in cents per net ton):

To	Prop.	To	Prop.
Coventry	160	Killawog	180
Brisben	160	Lisle	180
Greene	160	Whitney Point	180
Willard	160	Binghamton	180
Blodgett Mills	180	Johnson City	180
Messingerville	180	Vestal	180
Marathon	180		

(See Note 4.)

24897. Revise Footnote A as shown on page 77 of Agent Curlett's I. C. C. A-265 permitting application of rates on **quartz, silica and silex sand** to apply to destinations on the Canadian National Rys., Toronto, Hamilton & Buffalo R. R., when originating at all shipping points in Trunk Line territory; also to revise Footnote B shown on page 75 of same tariff to permit application of rates on **glass sand** to apply to Canadian destinations when originating at all shipping points in Trunk Line territory.

26769. Cancel present commodity rates applying on **sand, common or building** (not blast, engine, fire, foundry, glass, molding or silica sand) **and gravel,** carloads (See Note 2), from Adams Center, Watertown, Calcium and Gouverneur, N. Y., to destinations on the N. Y. C. R. R. as published in Items 1075, 1080, 1630 to 1660, inclusive, and 1795 to 1830, inclusive, of N. Y. C. R. R. I. C. C. N. Y. C. 15844. Classification basis to apply. Reason—Investigation develops no traffic has moved for some time, nor are there prospects for future shipments, therefore rates are obsolete.

26779. **Sand,** other than blast, engine, foundry, molding, glass, silica, quartz or silex, carloads (See Note 2), from Morrisville and Tullytown, Penn., to Honey Brook, Penn., $1.25 per net ton. (Present rate, $1.50.) (See Note 4.)

26781. (A) **Sand, building, carloads;** (B) **Sand, blast, engine, foundry, molding, glass, silica, quartz or silex,** carloads (See Note 2), from Mapleton District, Penn., to Ithaca and East Ithaca, N. Y., (A) $2.50 and (B) $2.75 per net ton. Reason—Proposed rates are comparable with rates to Buffalo, Geneva and Rochester, N. Y.

26783. **Sand,** other than blast, engine, foundry, glass, loam or molding, when shipped in open-top cars, carloads (See Note 2), from Point Marion, Penn., to Cumberland, Md., $1.20 per net ton. (Present rate, $1.60.) (See Note 4.)

26785. **Crushed stone,** carloads (See Note 2), from Lime Crest, N. J., to Honesdale, Penn., $1.40 per net ton. (Present rate, $1.60.) (See Note 4.)

26787. **Sand and gravel,** carloads (See Note 2), from South Lakewood and Farmingdale, N. J., to Port Monmouth, N. J., 50c per net ton. (Present rate, 60c.) Reason—To meet water competition.

26312. (A) **Sand,** in open-top cars, carloads, (B) **Sand,** in box cars or closed equipment, carloads (See Note 2), from Pinewald, Quail Run and Toms River, N. J., to Kennett Square, Penn., (A) $2.25, (B) $2.45, and to Frederick, Md., (A) $2.45, (B) $2.65 per net ton.

CENTRAL FREIGHT ASSOCIATION DOCKET

28224. To establish on **agricultural limestone, unburned,** in open-top cars; **stone, crushed,** in bulk, in open-top cars, and **stone screenings,** in bulk, in open-top cars, carloads (See Note 3). Rates in cents per net ton.

To Erie R. R. destinations	—From Marble Cliff, O.— Present Via	Rate	Proposed Rate	Route
Kings Creek, O.	A	*	85	A
Woodland, O.	B	*	85	A and B
Green Camp, O.	B	*	85	A and B
Martel, O.	B	*	90	B
Ontario, O.	B	*	100	B
Pavonia, O.	B	*	105	B
West Salem, O.	B	*	115	B
Wadsworth, O.	B	*	125	B

To Erie R. R. destinations	From West Columbus, O. Present Via	Rate	Proposed Rate	Route
Kings Creek, O.	C	*	85	C
Woodland, O.	C	*	85	C
Green Camp, O.	C	*	85	C
Martel, O.	C	*	90	C
Ontario, O.	C	*	100	C
Pavonia, O.	C	*	105	C
West Salem, O.	C	*	115	C
Wadsworth, O.	C	*	125	C

*Sixth class.

A—P. R. R., Urbana, O., Erie R. R.
B—P. R. R., Marion, O., Erie R. R.
C—N. Y. C. R. R., Peoria, O., Erie R. R.

28243. To establish on **crushed stone,** carloads (See Note 3), from Thrifton, O., to Batavia, O., rate of 100c per net ton. Present rate, 110c. Route—Via B. & O. R. R., Bond Hill, O., and N. & W. Railway.

28261. To establish on **crushed stone,** carloads (See Note 3), from North Baltimore, O., to Medina, O., rate of 85c per net ton. Present rate, 90c.

28262. To establish on **sand and gravel,** carloads (See Note 3), from Somerdale and Valley Junction, O., to New Philadelphia, Penn., rate of 80c per ton of 2000 lb. Present rate, 90c.

28264. To establish on **lake sand,** carloads, loaded in open-top cars (See Note 3), from Fairport Harbor, O., to Pittsburgh, Penn., rate of $1.20 per net ton. Present rate, 17½c (classification basis). Route—Via B. & O. R. R. direct.

28279. To establish on **agricultural lime,** carloads, minimum weight 30,000 lb., from Scioto, O., to points in Ohio:

To	Pres.	Prop.	To	Pres.	Prop.
Bayard	15	10½	Jeffersonville	12	9
Cannellville	12	9½	Killbuck	12½	9
Carbondale	13	10	Kingman	14	9½
Carrothers	11	8	Lordstown	14	9½
Castalia	12½	9	Maple Grove	12	8½
Clare	13½	10	Middletown Jct.	12½	9½
Dover	13½	10½	Mortimer	11	8½
Drakes	12	9½	New Pittsburgh	12½	9½
Falls Jct.	14	10	Sedalea	14	11
Galatea	11	8½	Slater	10½	8½
Hamden	12½	9½	Tontogany	12½	9
Hamler	12	9			
Hobson	14	10½			
Hopedale	15	11			

28261. To establish on **sand and gravel,** except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica, carloads (See Note 3), from Burr Oak, Ind. Rates in cents per net ton.

To N. Y. C. stations (Via La Porte, Ind.)	Present	Prop.
Pinola, Ind.	Sixth class	90
Durham, Ind.	Sixth class	90
Otis, Ind.	Sixth class	90
Burdick, Ind.	Sixth class	90
Chesterton, Ind.	Sixth class	95
Porter, Ind.	Sixth class	95
Dune Park, Ind.	Sixth class	95

28284. To cancel all rates published in B. & O. R. R. (East) Tariff I. C. C. 20976, applicable on **agricultural limestone,** carloads, from Howenstein and North Industry, O., to various destinations in Central Freight Association and Arbitrary territories, account obsolete.

28285. To establish on **crushed stone** (in bulk) and **limestone, unburned, agricultural** (in bulk, in open-top cars), carloads (See Note 3), from East Liberty, O., to other points in Ohio.

To (N. Y. C. stations)	Prop.	Pres.	To (N. Y. C. stations)	Prop.	Pres.
Fultonham	80	110	Shawnee	100	110
Zanesville	100	110	Hartleyville	100	*340
Crooksville	90	110	Hunterdon	100	*340
Tropic	100	110	Calvin	110	*390
Tatmans	100	110	Pomeroy	110	*390
Drakes	100	110			

*Sixth class.

28286. To cancel rate of 76c per ton of 2240 lb. on **limestone,** carloads, in open-top car equipment (See Note 3), between Bentley and Lowellville, O., on the one hand, and Sharon, Penn., on the other, as named in Items 432A and 433A of Supplement No. 7 to P. & L. E. Freight Tariff B No. 3254, also rate of 76c per ton of 2240 lb. on limestone, carloads, in open-top car equipment, between Lowellville, O., on the one hand, and Sharon, Penn., on the other, as published on page 79 of P. R. R. Tariff I. C. C. No. 58, account obsolete.

28302. To amend commodity description of Item 1330 of C. F. A. L. Tariff 130T, naming 83.33% of sixth class rating on **gravel, crushed,** in bags, minimum weight 50,000 lb., from points in Central Freight Association territory to points in Canada, to read as follows: "Gravel, crushed, in bags or in bulk, in box cars, minimum weight 50,000 lb."

28343. To establish on **limestone, agricultural** (not ground or pulverized) in bulk, in open top cars; **stone, crushed,** in bulk, in open top cars, and **stone screenings,** in bulk in open top cars, in straight or mixed carloads (See Note 3), from Narlo, Ohio. Rates in cents per net ton.

To	Pres.	Prop.
Stoneboro, Pa.	*	160
Franklin, Pa.	*	170
Oil City, Pa.	*	170
Warren, Pa.	*	200
Titusville, Pa.	*	210

*Sixth class.

28346. To establish on **crushed stone,** C. L., minimum weight when shipped in bulk, in open top cars, (See note 3), from Lima, Ohio, to Moulton, Ohio, rate of 70c per net ton. Route—D. T. & I. R. R., Slater, Ohio, and N. Y. C. R. R. Present, 80c.

28394. To establish on **sand,** except blast, engine, foundry, glass, molding or silica sand, and gravel, C. L. (See Note 1), from Evansville, Ind., to Browns, Ill., rate of 88c per ton of 2000 lb. Present rate—101c.

28397 (2). To establish on **agricultural lime,** C. L., minimum weight 30,000 lb., from McVittys, O., to Basil, O., rate of 8c. Present—10c.

27598. **Withdrawal Notice.** White Docket Advice 27598, Docket Bulletin 1932, dated February 16, 1931, covering proposal to amend Item 11640 of C. F. A. L. Tariff 218-G, naming rate of 31½c on **slag, slate, stone or gravel, crushed** or **ground,** from Chicago, Ill., to New York, N. Y., to include "granulated slag or granulated cinder," is hereby withdrawn from the docket.

28407. To establish on **sand and gravel,** except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or

silica, C. L. (See Note 3), from Burr Oak, Ind.

To—E. J. & E. R. R. (Via Hobart, Ind.)	Prop.
McCool, Ind.	90
B. & O. R. R. (Via Walkerton, Ind.)	
Alida, Ind.	90

Present rate: Sixth class.
(Rates in cents per net ton.)

28419. To establish on **stone, crushed** (in bulk), and **limestone, unburned, agricultural** (in bulk, in open top cars), in carloads (See Note 3). Rates in cents per ton of 2000 lb.

	From Genoa, Martin, O.	
To	Pres.	Prop.
Franklin, Pa.	430	160
Oil City, Pa.	430	160
Stoneboro, Pa.	430	150
Titusville, Pa.	440	200
Warren, Pa.	440	180
	From Apex, O.	
To	Pres.	Prop.
Franklin, Pa.	370	150
Oil City, Pa.	370	150
Stoneboro, Pa.	370	140
Titusville, Pa.	400	200
Warren, Pa.	420	180
	From Belleville, O.	
To	Pres.	Prop.
Franklin, Pa.	410	140
Oil City, Pa.	410	150
Stoneboro, Pa.	410	140
Titusville, Pa.	420	180
Warren, Pa.	420	170
	From Marblehead, O.	
To	Pres.	Prop.
Franklin, Pa.	(2)	150
Oil City, Pa.	(2)	150
Stoneboro, Pa.	(2)	140
Titusville, Pa.	265	190
Warren, Pa.	265	170
Andover, O.	151	140
Simons, O.	176	140
Jefferson, O.	151	140
	From Sandusky, O.	
To	Pres.	Prop.
Franklin, Pa.	220	140
Oil City, Pa.	220	140
Stoneboro, Pa.	220	130
Titusville, Pa.	240	180
Warren, Pa.	240	130
Andover, O.	120	.....
Simons, O.	140	130
Jefferson, O.	110	.....

(2) Combination basis.

28423. To establish on **sand and gravel**, C. L. (See Note 3), from Richwood, O., to Attica, O., rate of 85c per net ton. Present—13c (sixth class).

SOUTHERN FREIGHT ASSOCIATION DOCKET

54835. **Sand, gravel, crushed stone,** etc., carloads, from Chattanooga, Tenn., and N. C. & St.L. Ry. Stations to A. & W. P. R. R.-G. A. R. R. and A. B. & C. R. R. stations. It is proposed to apply single-line scale rates on sand, gravel, etc., as described in Item 5-A of Agent Glenn's Freight Tariff No. 88-A, I. C. C. No. A-655, from Chattanooga to destinations on A. & W. P. R. R., G. A. R. R. and A. B. & C. R. R. within 50 miles of Atlanta, Ga., in lieu of present joint-line scale rates, the Chattanooga rates to be observed as maximum. from intermediate points. Present and proposed rates from Chattanooga to representative points are as follows (in cents per ton of 2000 lb.):

To	Pres.	Prop.
East Point, Ga.	135	120
Decatur, Ga.	135	120
Tyrone, Ga.	140	130

54881. **Limestone, ground or pulverized,** carloads, from Ladds and Portland, Ga., to Chattanooga, Tenn. Present rates, from Ladds, Ga., 162c; Portland, Ga., 172c per net ton. Proposed rates on limestone, ground or pulverized, carloads (See Note 1), except when cars are loaded to their visible capacity actual weight will govern to Chattanooga, Tenn., from Ladds, Ga., 149c; Portland, Ga., 158c per net ton.

54890. **Sand, gravel, crushed stone,** etc., carloads, from Haile, Kendrick, Lary and Williston, Fla., to points in South Georgia and North Florida. It is proposed to establish rates on the above named commodities from and to the above named points on basis of the Docket 17517 Joint Line Scale, without the addition of the Florida arbitrary.

54914. **Silica,** crude, C. L., from Kings Mountain, N. C., to Copperhill, Tenn. Present rate, 35c per 100 lb. (8th class). Proposed rate on silica, crude, C. L., minimum weight 50,000 lb. from Kings Mountain, N. C., to Copperhill, Tenn., 20c per 100 lb.

WESTERN TRUNK LINE DOCKET

3089-L. **Limestone, ground,** carloads (See Note 2), but not less than 40,000 lb., from Quincy, Ill., to Sioux City, Ia. Present rate, 16c per 100 lb.; proposed, 11½c per 100 lb.

4742-J. **Sand and gravel,** carloads (See Note 3), from Chillicothe, Ill., to stations on the A. T. & S. F. Ry. in Iowa and Missouri.

		(21755) (Scale)	
To (representative points)	Miles	Pres.	Prop.
New Boston, Ia.	113	160	115
Dumas, Mo.	122	160	120
Medill, Mo.	133	160	125
Hurdland, Mo.	170	160	140
La Plata, Mo.	182	160	145

(Complete copy of exhibit will be furnished on request.)

7589. **Limestone, agricultural,** carloads (See Note 2), but not less than 40,000 lb., between all points in the state of South Dakota. Rates: Present, not specific rates; proposed, 90% of the present commercial crushed stone rates.

6025-D. **Limestone, agricultural,** carloads (See Note 3), but not less than 60,000 lb., from Valmeyer, Ill., to points in Missouri on the M.-K.-T. R. R. Present rate, combination rate over St. Louis, Mo.; proposed, to representative points from Valmeyer, Ill., mileage via M. P., St. Louis, M.-K.-T.

To	Miles	Rate	To	Miles	Rate
Black Walnut	56	100	Franklin	215	165
St. Charles	65	105	Columbia	205	165
Mokane	151	145	Moberly	250	175

2556-W. **Sand, gravel,** as described in Item 2020 series, W. T. L. Tariff 50-N, from Browntown, Wis., to Iowa destinations, as per Item 2020, W. T. L. Tariff 50-N. Present rates, Chicago basis; proposed, Peoria basis.

5319-E. **Sand and gravel,** carloads (See Note 2), but not less than 40,000 lb., from Brockmann Spur, Neb., to Sioux City, Ia. Present rate, 8c per 100 lb.; proposed, 4½c.

7595. **Sand, molding** (See Note 3), from Carpentersville, Ill., to Crown Point, Ind. Present rate, $1.71 per net ton; proposed, $1.39.

ILLINOIS FREIGHT ASSOCIATION DOCKET

6146. **Crushed stone,** carloads (See Note 1), to Olney and Browns, Ill. From Anna, Krause and Stolle, Ill., present, class rates; proposed, $1.13 per ton. From Falling Springs, Ill., present, class rates; proposed, $1.23 per ton.

3330-M. **Sand and gravel,** carloads (See Note 1), from Chillicothe, Ill. (rates in cents per net ton):

To	Pres.	Prop.
Surrey, Ill.	100	88
Cameron, Ill.	100	88
Nemo, Ill.	100	88
Ormonde, Ill.	101	88

6145-A. **Crushed stone,** carloads, from Anna, Krause, Stolle and Falling Springs, Ill., to Olney and Browns, Ill.

From	Pres.	Prop.
Anna, Krause and Stolle, Ill.	*	1.13
Fallings Springs, Ill.	*	1.23

*Class rates.

SOUTHWESTERN FREIGHT BUREAU DOCKET

22751. **Agricultural limestone,** between points in Oklahoma and points in Kansas on N. E. O. R. R. To add the N. E. O. R. R. as a Kansas line in Item 7000E of S. W. L. Tariff 44-O. The rates on agricultural limestone shown in Item 7000E do not apply to points on the N. E. O. R. R. in Kansas, although they apply from N. E. O. R. R. points in Oklahoma to points on the Missouri Pacific, M.-K.-T., St. L.-S. F., etc., in Kansas via the N. E. O. Kansas junctions. The rates also apply to points on other lines in Kansas, such points being served by the N. E. O. R. R.; for example, Columbus, Weir City, Scammon and Carona, Kan. It is stated the proposed application will remove present inconsistencies and provide appropriate rates to N. E. O. R. R. points.

22773. **Rip rap and crushed stone,** from Pilot Knob, Mo., to Kansas City, Kan. To establish a rate of 210c per ton of 2000 lb. on rip rap (irregular shaped rock) in pieces ranging up to 200 lb. in weight, carloads (See Note 3), from Pilot Knob, Mo., to Kansas City, Mo. It is stated that the above rate is necessary to move the traffic.

22788. **Stone, crushed, asphalt coated,** from Blackwater, Mo., to points in Missouri. To publish from Blackwater, Mo., to points in Missouri the single-line mileage rates as shown in Item 1050-C of Missouri Pacific Tariff 6172-E and the joint-line mileage rates as shown in Item No. 926-C of W. T. L. Tariff 91-F. The proposed rates are now in effect from Webb City, Mo., and were prescribed by the Missouri Public Service Commission in Case No. 4233, dated April 7, 1925, and later voluntarily published from other specific points to points in Missouri. Shipper at Blackwater, Mo., desires the establishment of the same mileage rates from that point.

22794. **Chatt sand,** from points in Kansas and Missouri to Indianapolis, Ind. To establish a rate of 353c per ton of 2000 lb. on chatt sand, carloads, minimum weight 100,000 lb., from Baxter Springs, Galena, Kan., Cagle, Carl Jct., Carterville, Carthage, Duenweg, Joplin, Oronogo, Oronogo Jct., Smithfield, Webb City, Mo., also from other points in the Tri-State District on other lines on request to Indianapolis, Ind. The rate above proposed to Indianapolis is now in effect to nearby points such as Bloomington, Bedford and Oolitic, Ind., per St. L.-S. F. Ry. Tariff 4288F, also in Missouri Pacific Tariff 7744K. The stone cutters at Indianapolis are in competition with those at the other points named above and they request that these rates be placed on a parity with their competitors.

I. C. C. Decisions

22691. Cement. Dewey Portland Cement Co. et al. vs. Atchison, Topeka and Santa Fe et al., a sub-number thereunder. Same vs. Cedar Rapids and Iowa City et al.; 22780, Lehigh Portland Cement Co. et al vs. Same; and 22184, State Cement Commission (of South Dakota) vs. Atchison, Topeka and Santa Fe et al. The I. C. C. has found the intrastate rates on cement from Louisville, Neb., to Omaha, Neb., and intermediate points unduly preferential of Louisville and of intrastate traffic from that point and unduly prejudicial to complainants and unduly discriminatory against interstate traffic from Iowa producing points.

Further findings are that the carload rates on cement from Iowa producing points to destinations in Iowa, Missouri, Minnesota, Nebraska and South Dakota are not unreasonable or unduly prejudicial compared with the rates from Louisville, Neb., or Rapid City, S. D.; that the interstate carload rates from Rapid City are not unjustly discriminatory against interstate commerce or unduly preferential as compared with Iowa producing points; and that the carload rates from Rapid City to St. Paul and Minneapolis, Minn., and intermediate points are not unreasonable or otherwise unlawful. All except the title complaint have been dismissed.

The commission said these cases grew mainly out of the construction of cement mills at Louisville and Rapid City after the general cement adjustment was prescribed in Western Cement Rates, 48 I. C. C. 201. Louisville, it was pointed out was in scale III territory, was 10 miles west of Oreapolis, Neb., a border point between scale II and scale III territories, and Rapid City was in scale IV territory.

The commission said that it found scale II rates prescribed in Western Cement Rates would be reasonable for application from the complainant cement producing points to Omaha and to points intermediate thereto in respect of Louisville as an origin point; that there was competition between complainants' plants and the plant at Louisville in respect of cement shipped to and sold at such point; that the transportation conditions between the interstate and intrastate movement were substantially similar; and that when and to the extent that the intrastate rates from Louisville to such destinations were lower, distance considered, than rates constructed under scale II, they were unduly preferential of the shipper at Louisville and its traffic, unduly prejudicial to the complainants' plants in Iowa and their traffic, and unjustly discriminatory against interstate commerce, and it said that the undue preference and unjust discrimination should be removed by the establishment of intrastate rates on the basis no lower than scale II rates.

The commission said it would enter no order at this time but would leave to the Nebraska commission and the carriers the matter of adjusting intrastate rates which would harmonize with the intrastate rates herein approved. It said that if such readjustments were not effected within a reasonable time the interested parties might bring the matter to its further attention.

Commissioner Eastman, dissenting in part, said that in his judgment the Rapid City mill had been given rates by the South Dakota Commission which were unduly preferential and unduly prejudicial to mills situated in

neighboring states. To the Twin Cities, on the other hand, he said, the Rapid City mill had not been given such rates which were fairly related to the rates which the commission had prescribed to those destinations from competing mills.

22855. Sand and Gravel. Neal Gravel Co. vs. Wabash R. R. Co. Sand and gravel carload rate from Wolcottville, Ind., to Detroit, Mich., found unreasonable. Reparation awarded. Shipment of 63 carloads of sand and gravel from Wolcottville, Ind., used in grade work involving separation of public highway from defendant's railroad, part of expense of which was to be borne by defendant. Defendant agreed to establish a 75c. rate that it might haul material and obtain revenue. Complainant obtained contract on this basis. Rate sought was not established prior to movement because of delay in reissuing tariff.

Complainant states sand and gravel shipped to Detroit is highly competitive and that it secured this contract in competition with producers in surrounding states, some of whom were able to supply the material at a rate of 75c or less. Defendants introduced no evidence.

22257. Reinforced-Concrete Pipe. South Dakota Concrete Products Co. et al. vs. Chicago and North Western Railway Co. et al. Rates on reinforced-concrete pipe, in carloads, from Watertown and Canton, S. D., and Schmidt, N. D., to various interstate destinations in North Dakota and South Dakota found not unreasonable. Complaints dismissed.

This decision was based on the Western Trunk-Line case, decided subsequent to the hearing under consideration. In that proceeding distance scales of class rates for western trunk-line territory were prescribed. The territory considered in the instant case is included in the Western Trunk-Line case. The varying transportation conditions throughout western trunk-line territory are accurately reflected in the scales prescribed.

23723. Cement. North American Cement Corp. vs. Central Railroad Co. of New Jersey et al. Rate on cement, in carloads, from Alsen, N. Y., to Newark Heights, N. J., found unreasonable. Reparation awarded. Complainant alleges rate charged on six carloads of cement, shipped from Alsen, N. Y., to Newark Heights, N. J., in May, 1928, unreasonable.

Charges were collected at the applicable combination rate of 23c. Reparation was sought to the basis of a rate of 12½c. In August, 1928, a rate of 14c. was established from Alsen to Newark Heights. Effective February 1, 1929, a rate of 12.5c. was established. A number of instances of freight rates on cement of 12.5c. or less for shipment the same distance were cited by complainant.

Railroads Win Switching Rate Case in Iowa

THE RIGHT of "line haul" railroads in Iowa to limit the amount of charges to be absorbed by them for switching in the hauling of gravel was upheld by Judge John J. Halloran in a recent decision.

The ruling was made in connection with the suit of the Chicago, Milwaukee, St. Paul and Pacific and the Chicago, Rock Island and Pacific railroads against the Iowa board of railroad commissioners and Burlington, Muscatine and Northwestern railroad.

The Burlington, Muscatine and Northwestern road is a switching road engaged in hauling gravel from gravel pits along the Mississippi river to the Muscatine freight terminal used by the Milwaukee and Rock Island roads.

Previous to last December the two plaintiff railroads operated under an agreement sanctioned by the railroad commission in which they agreed to absorb the shipper's cost of switching the gravel from the pits to their terminal, providing the "line haul" cost totaled a specified amount. They set the absorption limit, however, at $4.50 for 50-ton cars.

In a ruling made late in 1930, the railroad commissioners knocked out the absorption limit set by the roads and allowed an absorption rate of $5 in cases of cars with 70 tons capacity.

Judge Halloran overruled the commissioners and held that the railroads could maintain the lower absorption limit. Because the matter of absorbing the switching charge by the plaintiff roads was a "gratuity," Judge Halloran held that the plaintiffs had a right to limit the amount which they should absorb, providing they did not discriminate against the shippers of Muscatine or others similarly situated.

Judge Halloran set a precedent through his decision, as the Iowa supreme court has never acted on the question decided. The case was on trial for several days.—*Des Moines* (Ia.) *Register.*

Reports Rate Cut Helps Janesville, Wis., Gravel Business

THE RECENT 20% reduction in sand and gravel freight rates to Milwaukee is resulting in somewhat increased sales from Janesville of these products, although the season is too early as yet to determine the exact amount of benefit to the derived from the lowered rate. The cut was effected to permit more effective competition locally with firms close to Milwaukee taking advantage of reduced transportation rates by trucking companies.

"Our Milwaukee business has increased slightly as a result of the freight cut," G. F. Ehrlinger, secretary-treasurer of the Janesville Sand and Gravel Co., reports. "It is our expectation that we shall get a larger percentage of the Milwaukee orders than we did last year as a result of the cut, but it is too early to predict the exact amount of benefit we shall derive."

The two local railroads are now hauling approximately 75 cars of sand and gravel from here daily. A decided increase in shipments has been noted during the past month as a result of the opening of the construction season.

Considerable benefit to local sand and gravel firms would result if the proposed subways materialized in Chicago, it is believed.—*Janesville* (Wisc.) *Gazette.*

Georgia Sand-Gravel Rate Order Attacked in U. S. Court at Washington, D. C.

THE GEORGIA PUBLIC SERVICE COMMISSION has attacked in the Supreme Court, at Washington, D. C., orders of the Interstate Commerce Commission setting aside of the Georgia commission on gravel and stone between points in that state.

The federal commission had substituted the same basis rates for intrastate shipments approved as a maximum for interstate rates.

The Georgia commission contended that orders of the Interstate Commerce Commission invaded soverign rights, were arbitrary, unlawful, and prescribed an invalid rate making formula.

Edgar Watkins, of the Georgia State Highway Board, also urged the court to set aside the orders.

Daniel W. Knowlton, for the Interstate Commerce Commission, and R. C. Alston, for the Atlantic Coast Line Railroad Company, and other railroads, supported the orders, contending they were clearly within the authority of the federal commission.

It was contended that the federal commission had ordered these rates so that interstate shippers could compete for business in Georgia.

Cement Rate Ruling Affirmed

AFTER rehearing the state railroad commission has reaffirmed its previous order on the complaint of the Riverside Portland Cement Co. and California Portland Cement Co., against Southern Pacific Co. and other rail carriers, in which it was alleged that rates for the transportation of cement from Colton and Crestmore to Los Angeles and territories west and north thereof were unjust and unreasonable, unduly prejudicial and discriminatory to complainants' mills at Colton and Crestmore, and preferential to competing mills at Monolith, Oro Grande and Victorville. However, the commission modified its previous decision dismissing the complaint, and modifying the rates from Monolith, Oro Grande and Victorville to points beyond Los Angeles.—*Riverside* (Calif.) *Press.*

Rockford Producers Seek Lower Sand and Gravel Rates

AN ATTEMPT to obtain lower freight rates that will put Rockford, Ill., sand and gravel producers on a better competitive basis with dealers of nearby towns was made, April 14, at an Interstate Commerce Commission hearing in Chicago.

Existing rates to Chicago now are 70 cents a ton for a single line haul on all roads except the Burlington, which charges 75 cents, and for joint hauls 90 cents on all roads except the Burlington, where a charge of 95 cents is made.

A rate of 60 cents for single line hauls and 70 cents for joint hauls is needed here, it is claimed. Joliet, Plainfield and Munger recently have received a reduction to 55 cents, making competition by Rockford interests difficult.—*Rockford* (Ill.) *Republican.*

First aid teams in action at safety meeting at Albany, N. Y.

Safety Talks and Demonstrations

ONE of the most enthusiastic safety meeting of the year, and the largest of its kind yet held in New York state, convened in Albany on Wednesday, April 15. The following mills, located in eastern New York, New England and Quebec, were represented: Alpha Portland Cement Co., Cementon and Janesville, N. Y.; Canada Cement Co., Ltd., Montreal, Hull, P. Q.; Glens Falls Portland Cement Co., Glens Falls, N. Y.; Lawrence Portland Cement Co., Thomaston, Maine; Lone Star Cement Co. of New York, Hudson, N. Y.; National Cement Co., Montreal, P. Q.; North American Cement Corp., Catskill and Howes Cave, N. Y.; Pennsylvania-Dixie Cement Corp., Portland Point, N. Y.; and Universal Atlas Cement Co., Hudson, N. Y. There was a total attendance of 122, including 110 mill representatives.

Morning Session

R. A. Dittmar, superintendent of the Universal Atlas plant at Hudson, acted as general chairman. In opening the meeting, Mr. Dittmar said in part:

"In behalf of the association, it is a pleasure to welcome you men to this Albany safety meeting. We have met here in the interest of a common cause. In our untiring endeavor to eliminate accidents, we must be constantly alert. Through our educational work we are endeavoring to develop those mental reflexes that make for cautious and careful habits. We know that this subject of teaching our men to be safety-conscious is now the most important feature in our safety work and that when we can reach this objective and maintain it, we will not have accidents.

"These regional meetings give us a splendid opportunity to exchange ideas. We have all developed original ways and means to sell safety in our organizations and we are constantly on the lookout for new educational methods as a means of keeping this subject alive. Let us make the best of the opportunity offered here today. In our safety work at home we teach co-operation and we are always striving to develop that friendly feeling throughout our organization that makes for co-operation. Let us develop this same friendly feeling of co-operation here at this meeting.

"Before we go ahead with our program, I wish to salute those men with us representing organizations that won the safety trophy last year. The plants represented at this meeting that operated with a perfect safety score last year are:

"Alpha plant at Cementon, N. Y.

"North American plant at Howes Cave, N. Y.

"Pennsylvania-Dixie plant at Portland Point, N. Y.

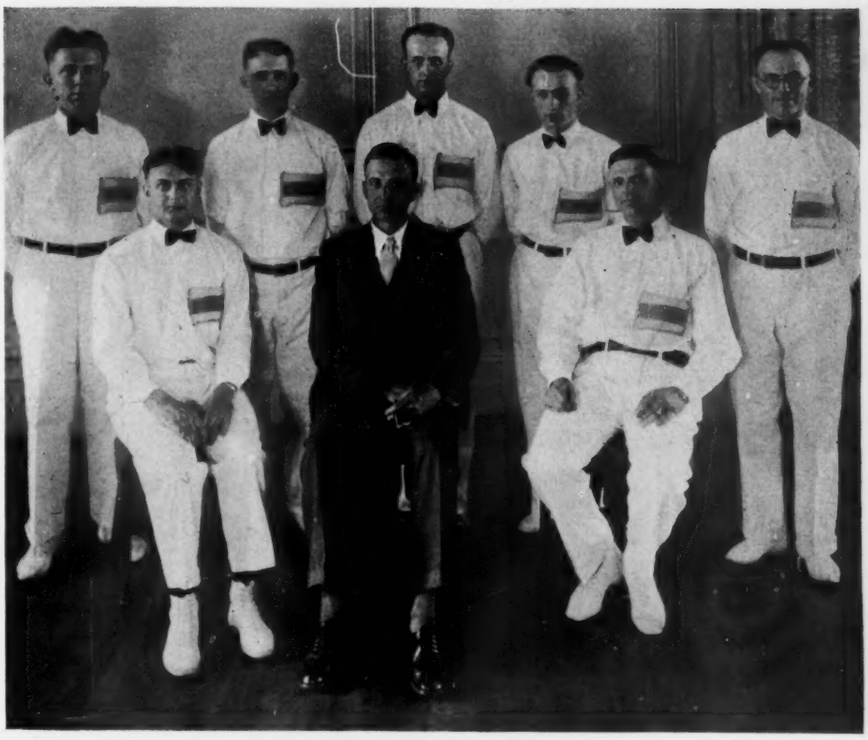
"It is our hope that the records that these three plants have established will continue indefinitely and in the interest of every cement worker in this region, it is our hope that similar records will be established by all the organizations represented at this meeting."

The first paper on the morning program was a report of "The Progress of the Accident Prevention Program During 1930," which was given by **Stanley Owens,** safety engineer of the Portland Cement Association.

The main features of this report were the 37% reduction of all accidents in the cement industry in 1930, and the interesting sidelights in connection with the winning of the Portland Cement Association

trophy by forty-three cement plants last year.

J. D. Allardice of the Universal Atlas Cement Co. at Hudson, N. Y., was next introduced and presented an interesting paper entitled, "The Trophy Contest in New York State." Following this paper, **S. H. Rhodes** of the North American Cement Corp. at Howes Cave, N. Y., presented a paper entitled, "Winning a Safety Trophy." The next subject which was entered into by practically every plant present was entitled, "The One Most Effective New Idea Used by Our Company Last Year to Prevent Accidents." Representatives of the various mills reported as follows:



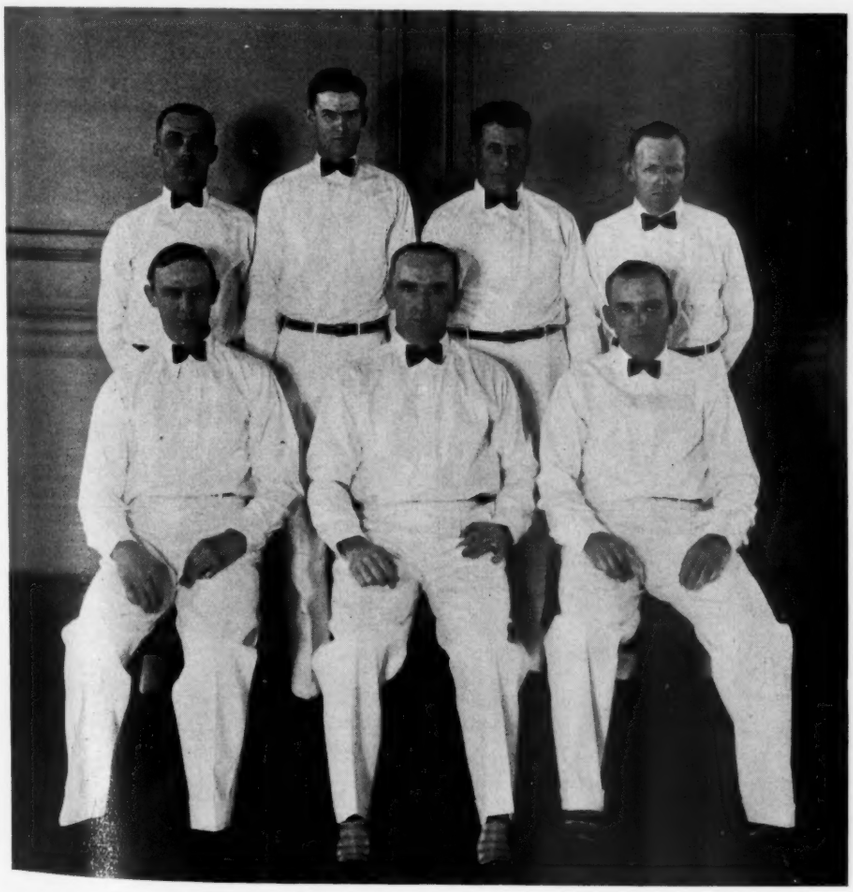
First aid team of North American Cement Corp., Howes Cave, N. Y.

The One Most Effective Idea

E. C. Sandt (Alpha, Cementon): The education of each individual man, by personal contact, was the most effective idea employed at our plant.

W. H. Grady (Canada, Montreal): During our present large rebuilding program it was decided that with 600 additional men and the hazards created by them, the operating department should not leave the construction department to its own resources but should strive to assist and protect the latter by all means.

D. A. Gasper (Canada, Hull): One man in each department was selected from the ranks to attend each weekly safety meeting of the committee, so that in a short time there were many men in the mill who had sat with the safety committee and were informed as to what the latter was doing.



First aid team of Universal Atlas Cement Co., Hudson, N. Y.

D. A. Ennis (Lawrence, Thomaston): Competent committee to investigate all accidents proved valuable.

O. E. Wishman (Lawrence, Thomaston): All violators of safety rules are tried before a police court, with good results.

L. R. Pritchard (Lone Star, Hudson): Hudson plant has found that good housekeeping is a powerful factor in preventing accidents; as a result the plant is kept fit for rigid inspection at all times.

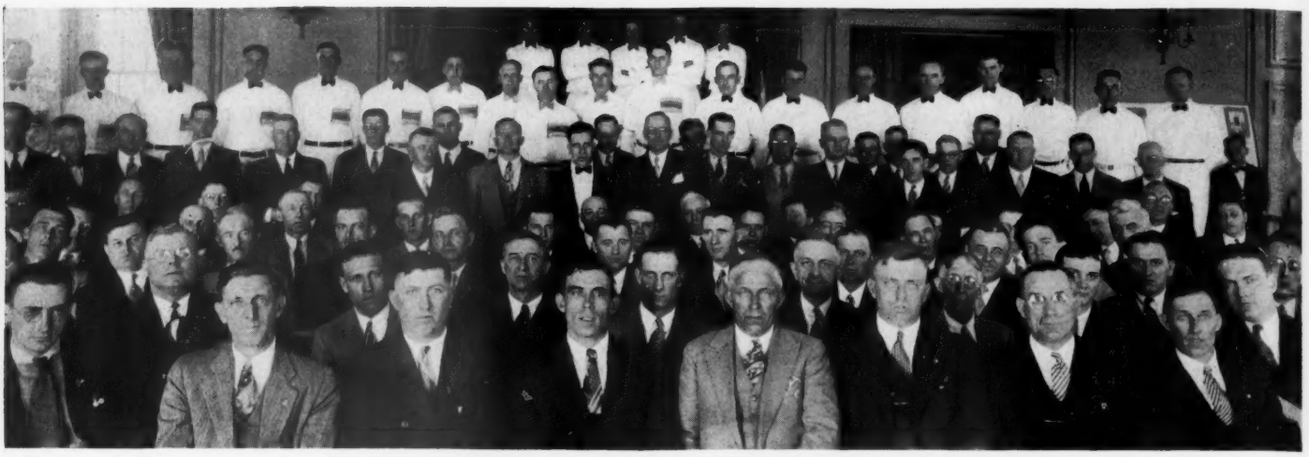
C. E. Smith (National, Montreal): Physical examination of employes has been found a splendid help in reducing accidents.

John League (North American, Catskill): Departmental safety meetings, held every Saturday noon, have been found very helpful. They last 5 to 20 minutes, the program consisting of one or more five-minute talks. Brief talks seem to hold the interest.

Harry Greenwald (North American, Howes Cave): Thorough investigation of all accidents has been found one of the most effective safety helps at this plant.

F. P. Werner (Penn.-Dixie, Portland Point): Holding of mass meetings each month, in which diversified amusement features are introduced, has been found effective in creating harmony and insuring co-operation among the men. This has had a direct effect on the reduction of accidents.

J. P. Flannery (Universal Atlas, Hudson): Advertising committee at Hudson



Regional safety meeting of Portland Cement Association at Albany, N. Y.

plant has been of greatest help by driving home the safety idea through forceful and interesting messages, ingeniously carried home to the workmen.

Several of the plants displayed advertising material, safety posters and other display features used to increase interest in safety. These displays were placed around the walls of the ballroom in which the meeting was held and showed much publicity talent in the various organizations.

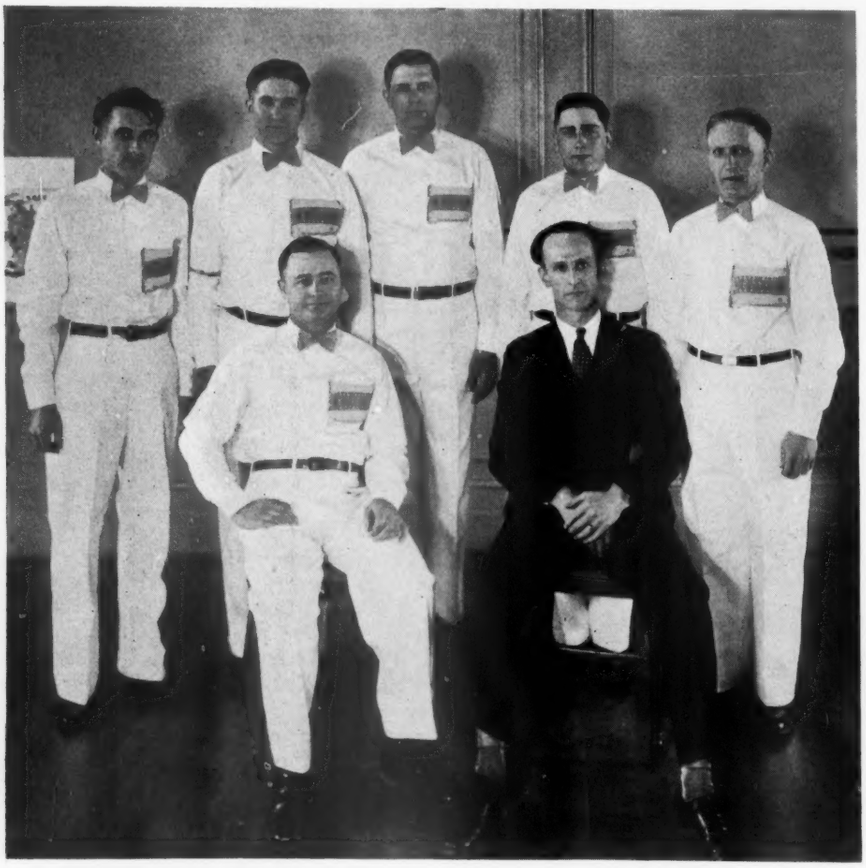
Luncheon

Charles R. Parks, treasurer of the North American Cement Corp., presided very acceptably at the luncheon, which was given in the Cameo room of the Ten Eyck Hotel. **R. A. Dittmar** presented a letter from **F. W. Kelley**, president of the North American Cement Corp., and was instructed to wire greetings from the meeting to Mr. Kelley. A characteristic paragraph from Mr. Kelley's letter read as follows:

"I regret exceedingly that I cannot greet each of you in person as in the past, but greatly appreciate this opportunity to both congratulate you on past records and exhort you to new accomplishments. We must continue as crusaders in our great cause, and as Theodore Roosevelt used to say, 'With grim energy and resolute courage move on to better things'."

A telegram was then read from **J. J. Porter**, vice-president and general manager of the North American Cement Corp., in which he sent his regrets in not being able to be present at the meeting and his best wishes for its success.

Toastmaster Parks then introduced the Hon. **John Boyd Thacher II**, mayor of Albany. Among other interesting statements, Mayor Thacher said: "The success that has attended your efforts and the notable record that your industry has compiled in the face of difficulties stamp you as foremost in the field of accident prevention. For that fine success, for that distinguished record, I extend congratulations and best wishes for the success of this as well as your other regional safety meetings."



First aid team of North American Cement Corp., Catskill, N. Y.

Afternoon Session

H. F. Kichline, superintendent, North American Cement Corp., Catskill, N. Y., presided at the afternoon session introducing first **Carl Erdman**, superintendent of the Lone Star Cement Co., Hudson, N. Y., who presented a paper, "Safety as an Operating Problem." The philosophy of Mr. Erdman's paper is contained largely in the following trite sentences:

"What the Big Boss says and does usually 'goes.' The entire supervisory force is prone to accept as worth emulating, what the man higher up is willing to do; while on the other hand, many a foreman lacks the same interest in those things that are initiated by the men under him. The responsibility rests with the management."

E. W. Farris, assistant superintendent, North American Cement Corp., Catskill, N. Y., next presented a paper on the "Investigation of Employe Accidents." In Mr. Farris' paper he stated: "Accident investigation if properly handled and the facts derived therefrom wisely used could

be also termed as first aid to safety, first aid to correcting hazardous conditions, first aid to prevention of recurrence of accidents and first aid to the promotion of a safety 'habit'."

An interesting discussion followed this paper with reference to penalizing employes for infractions of safety rules.

Murray D. Smith of the Bullard-Davis Co. then read a paper entitled, "The Value of Emergency Equipment." Mr. Smith stated: "Safety equipment and safety education are complementary, must be present together and must be used together. One is of little or no value without the other. As a corollary to this it goes without saying that when the management has instructed its employes to use certain pieces of safety equipment in certain operations, such equipment should be available and readily used by the employes."

J. G. Steffen of the Mine Safety Appliances Co. also gave an interesting extemperaneous discussion on resuscitation.

First Aid Contest

At this point, the meeting was turned over to **E. H. Parry,** safety director of the Glens Falls Portland Cement Co., Glens Falls, N. Y., who acted as chairman of the first-aid contest, assisted by the following committee: S. P. Howell, U. S. Bureau of Mines, Pittsburgh, Penn., chief judge; J. M. Webb, U. S. Bureau of Mines, Pittsburgh, Penn., supervising judge; J. G. Steffen, Mine Safety Appliances Co., New York, supervising judge; R. A. Bloomsburg, New York Power & Light Corp., Albany, N. Y., judge; J. J. O'Neil, General Aniline Works, Rensselaer, N. Y., judge; Lieut. Richard Fleming, Albany Fire Department, judge; Captain Kinary, Albany Fire Department, judge; J. G. Dreher, Universal Atlas Cement Co., Hudson, N. Y., recorder; Morris Fortuin, Pennsylvania-Dixie Cement Corp., timekeeper.

There were four teams entered in this contest, one each from the Catskill and Howes Cave plants of the North American, and one each from the Universal Atlas Hudson plant and the Glens Falls plant, the latter team winning the contest with a score of 99.733.

Banquet

The day's session was drawn to a close at a banquet in the Gold room of the hotel at which **Morris Fortuin,** general manager of the northern division of the Pennsylvania-Dixie Cement Corp., acted as toastmaster. The Hon. **Daniel V. McNamee**, Justice of Supreme Court of the State of New York, was the principal speaker of the evening. He made a very inspirational address on "Good Citizenship and Safety." Following Mr. McNamee's speech, **E. H. Parry** announced his own company as winner of the first aid contest and presented the silver trophy.

Big Meeting at Davenport, Iowa

WITH a total registration of 213, the Davenport Regional Safety Meeting of the Portland Cement Association, held at the Blackhawk Hotel on April 2, proved to be the largest of the six regional meetings that have been held to date this year. There were nine cement plants represented, including those of the Alpha Portland Cement Co., LaSalle, Illinois; Dewey Portland Cement Co., Davenport, Iowa; Lehigh Portland Cement Co., Mason City, Iowa, and Oglesby, Ill.; Medusa Portland Cement Co., Dixon, Ill.; Northwestern States Portland Cement Co., Mason City, Iowa; Pennsylvania-Dixie Cement Corp., Des Moines, Iowa, and Universal Atlas Cement Co., Buffington, Ind., and Duluth, Minn.

H. F. Tyler

The meeting was opened with an address of welcome by **H. F. Tyler,** first vice-president of the Dewey Portland Cement Co.

A series of short talks was given by representatives from each of the plants represented at the meeting on the subject of "The One Most Effective Measure Employed by Our Company Last Year to Reduce Accidents." Extracts from some of these papers are here given.

Spirit and Enthusiasm

By R. K. Gimson, Chief Chemist, Alpha Portland Cement Co., La Salle, Ill.

The spirit and enthusiasm of the men at the plant has done the work. The cause for this better spirit was one branch of safety education which I shall call propaganda; the spreading of propaganda was very effective. The year 1930 called for turning the proverbial new leaf, and we began sending out our propaganda. The men were told that over four months of accident-free time preceded 1930, and that we now had the necessary momentum to carry us through an accident-free year. We explained that trophy winners were the best bet for future good records, and that we expected continued success.

All our meetings were purposely inspirational pep meetings, and a little of this collegiate bally hoo works pretty well in these gatherings. Winning a trophy was talked of as a certainty, as a foregone conclusion. The trophy, its location, dedication and the usual outing in this connection, were freely discussed at our meetings before the year was half over, and the men seemed to gain encouragement from the anticipation of what was to come. We taught that accidents in our industry were now the uncommon rather than the common occurrence, and that a good worker was considered to be a competent, safe worker. I believe that each man soon felt that were he injured, he would stand alone and fail to find the company that misery is supposed to love.

All Accidents Investigated

By E. N. Dodd, Safety Director, Penn.-Dixie Cement Corp., Des Moines, Iowa

The most effective measure that was brought into use in accident prevention work at our mill last year was the idea of appointing an investigating committee for the purpose of investigating all accidents, and near accidents, that were of serious enough nature to warrant an investigation, other than the usual one that follows every accident. Although this system of accident investigation has been employed by some of the mills for quite a while, it has only been used during the past 12 months at our mill.

This committee is composed of three workmen of equal rank, and does not include anyone in a supervisory capacity. A committee composed of workmen is educational to the members making the investigation because it discloses many unsafe practices which may have existed for a long time and which the members themselves may have followed, not realizing the hazards involved while doing so.

Personal Contact With Men

By E. Sterndorf, Assistant Safety Director, Universal Atlas Cement Co., Buffington, Ind.

Personal contact with each man is the biggest factor and as in the instance of our packing and loading department this was our "new idea" for 1930. The approximate number of men in this department is 175 for the year. We had been having a great many eye cases,

shots of hot cement from burst bags, and had tried out various eye shields—hoods—protectors—but none of them had proven satisfactory. Eye cases still came to our dispensary and it was decided to provide a goggle of an approved type and then see that each man wore them and be made to understand that they were a part of his work, something that would really be a benefit to him. If any of you have ever worn goggles you will understand what this meant. At the beginning of the year the assistant supervisor of the packing and loading department and the safety man started out and each week thereafter for several months interviewed all the men. At first it was a hard job. We caught a few of the men wearing their goggles on their caps or around their necks. They were told plenty. The supervisor soon saw that it meant money to him to keep his gang intact because they work on a per barrel basis and previously when a man got a shot it meant leading the man over to the dispensary and sometimes several hours loss, especially if one of them happened to be a malingerer.

This procedure resulted in a reduction of eye cases over the year previous of 78% and not one lost time case. Yet this was not a new idea. Just an old idea tried in a new way on old men. Enlarged on probably but most effective for us.

Use Psychology

By A. S. Hetherington, Universal Atlas Cement Co., Duluth Plant

No expense has been spared that is within reason to make our plant as safe as possible for the employes, but all the safeguarding we have done is just a small part of the accident prevention program. A safety guard on a machine, like a padlock on a door, is only a way of saying "stay out."

In order to have smooth and efficient operation, it is essential to have co-operation. Co-operation is something you can't make, or you can't buy. It is a quality, noticeable and forthcoming when there is a feeling of contentment and satisfaction applicable to mankind. What is the definition of co-operation? It means joint action. I have heard another definition of co-operation not given in the dictionary—co-operation is *something* that *you do* for others that you don't *have* to.

I am somewhat of a believer in psychology. If we apply the golden rule more I feel sure we will receive more co-operation. The day of the "hard boiled" foreman is gone. It isn't necessary any more to "bully" men in order to get them to do their work. Years ago it was possible to get work done by tantalizing the men, fear of losing their jobs, by sheer force, etc. But today the work can be done in a more safe and efficient method by approaching the individual in the right manner. All men are not alike. What one man might consider as a joke, another might consider as a rebuke. Explain the job to the man. Tell him about the operations of the department, how one operation depends on another. Explain to him that other operations in the mill are dependent on the manner in which he does his work and the kind of work he produces. If you tell him these things he will realize that his job is equally as important as the next man's job and will entertain a certain pride in doing it well.

If the man discharges his duties in a satisfactory manner, let him know about it at the time. Don't wait until he is gone to tell someone else how well he performed his duties. Give credit where and when credit is due.

Explain to him about the safety program being carried on, the safety achievements that have resulted only through the co-operation of every employe in the plant. Tell him that it is necessary for him to work safely as well as efficiently, and that all the other employes have pledged themselves to do the same. If a man is approached in the right manner, I fail to see, with but few exceptions, why he will not offer to co-operate to the fullest extent.

In order to be a trophy winner in the Portland Cement Association trophy contest it has become necessary to operate an entire year without a lost time accident. We have won this trophy three times, but it happened on alternate years.

It would seem from this evidence that during the year following a perfect safety record there was a tendency to rest on our laurels, which can not be done. It, therefore, proves that an intensive safety campaign is necessary every day of the month and every month of the year.

Then Some Discussion Followed

The presentation of these short talks brought forth a very interesting discussion which was entered into by a number of representatives present. Following this discussion, the Rev. George S. McClary of LaSalle, Ill., delivered an enlightening lecture on "The Problem of Life."

J. B. Lewis, assistant general superintendent, Buffington plant Universal Atlas Cement Co., closed the morning program with a paper on "Safeguarding Employes During Maintenance and Construction Work."

The Luncheon

Luncheon time found everyone with an appetite. **Lewis R. Sims,** safety director of the Dewey plant at Davenport, presided, and at the conclusion of the meal introduced **Eugene Walsh,** of Snider, Walsh and Hynes, insurance brokers, of Davenport, who made an inspirational address on the value of accident prevention work. Following Mr. Walsh, Dr. L.

M. Cofflan, of Davenport, spoke interestingly on "Human Values."

Afternoon Session

The afternoon session was called to order by **R. A. Bechtold,** superintendent of the Penn.-Dixie Cement Co., Des Moines, Iowa, who acted as chairman. **John Young,** superintendent of the Lehigh Portland Cement Co., Oglesby, Ill., was appointed discussion leader for the afternoon session, which opened with a paper on "Accidents Involving Powdered Coal" by **D. A. Davis,** power engineer, Northwestern States Portland Cement Co., Mason City, Iowa.

Following a discussion of Mr. Davis' paper, **A. C. Kluck,** power engineer, Lehigh Portland Cement Co., Mason City, Iowa, presented a paper on "The Investigation of Fatal and Serious Employe Accidents."

Employe Training Always a Good Topic

"The Proper Training of the New Employe" was the title of the next paper which was delivered by **M. L. Silcox,** chemist, Penn.-Dixie Cement Corp., Des Moines, Iowa, which was followed by an interesting discussion.

A feature of the afternoon session was a symposium, "How We Organized Our Plant to Win the Trophy," participated in by **J. W. Temm,** chief electrician and chairman, Safety Committee, Alpha Portland Cement Co., La Salle, Ill., and **W. M. Powell,** safety director, Medusa Portland Cement Co., Dixon, Ill.

The afternoon session was closed with a first aid contest between teams from the Oglesby plant of the Lehigh Portland Cement Co. and the Dewey Portland Cement Co. at Davenport Iowa. This test was conducted by **Claud P. Dempsey** with the assistance of Messrs. Ryan and Powell of the U. S. Bureau of Mines. The Dewey plant, with a score of 96.6, won the contest.

The Dinner

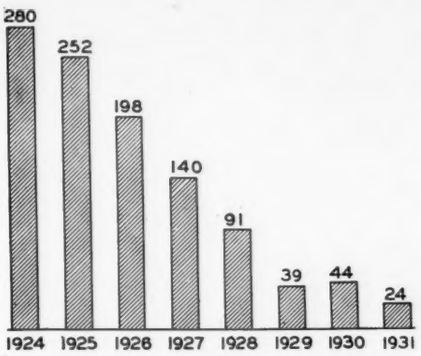
Nic Le Grand, insurance broker, Davenport, Iowa, acted as toastmaster at the banquet which brought the day's meeting to a close. **Lester Sidney** acted as song leader and every one present joined in the singing which was followed by some very good entertainment.

Trophy Presented

H. F. Tyler presented the silver trophy cup to his own team after stating that he was sorry he could not have had the pleasure of presenting this cup to the visiting team. **R. A. Bechtold** then summed up the day's program and was followed by **Roland L. Philbrook,** D.D., Davenport, Iowa, who gave a very enlightening lecture on human safety and drew from his experiences as chaplain of the Wyoming-State prison.

March Accidents

LOST-TIME ACCIDENTS occurring in the member mills of the Portland Cement Association during March set a new record for the month and were only 52% as numerous as during March, 1930. While the lower number of accidents during the month reflects the reduced scale of operation prevailing among the mills at present, it also indicates a drop in accidents per million barrels of cement manufactured. The first quarter of 1931 brought fewer accidents than any previous quarter since the record was started some 16 years ago. One hundred and ten plants got through the quarter without a reportable accident, as against 94 that were similarly successful during the first quarter of 1930.



Lowest March accident figures

Accidents reported during March, 1931, include 22 mishaps involving loss of time only and one which was fatal. There were no accidents resulting in permanent disability of any kind. The fatal accident occurred in the finishing department, to a foreman who was engaged in starting a tube mill. One of his hands was on the handle of a 550-volt compensator switch while the other was evidently grounded. He received a shock which was instantly fatal. The compensator case was not grounded. The Portland Cement Association has recommended that all metal non-current-carrying parts of electrical equipment be grounded, as required by national safety codes.

The following were among the more important accidents involving loss of time:

A backfire occurred while kiln was being lighted, severely burning face and hands of operator, with loss of 15 days' time. An electrician working on kiln control panel allowed screwdriver to slip, contacting live 550-volt terminals; his face, ears and hands were scorched, causing the loss of 45 days' time. A construction laborer chipping concrete was struck in eye with fragment, resulting in 6 days loss of time.

Brakeman was attempting to release brake on limestone car at crusher when the brake wheel spun and threw him to the ground; approximately 60 days will be lost. A repairman stepped on a nail, resulting in infection and 8 days loss of time. A construction laborer working with electric welder operator lost one day's time when flashes burned his eyes.

All of the above accidents were quite unnecessary, with the possible exception of the kiln backfire. Electricians working on live panels should have energized portions rubber blanketed; laborers chipping concrete should wear goggles, and welder helpers should wear eye shields; a stick should be used to hold tight brake wheels while dog is forced free.

Quarrying Accident Rate Lower in 1930

A REDUCTION of 13% in the accident rate for the stone-quarrying industry of the country in 1930 has just been announced by Scott Turner, director of the United States Bureau of Mines, Department of Commerce. Mr. Turner's statement is based upon reports which the Bureau of Mines has received from quarry operators that employ nearly three-fourths of the total number of men employed at all quarries in the United States. The reports cover the quarrying and crushing of stone and the manufacture of lime and cement, as well as rock-dressing done at the quarries.

A special tabulation of returns from operating companies received by the Bureau up to April 18 shows that accidents in 1930 occurred at a rate of 106 accidents for each thousand men employed. Reports from the same plants for the previous year showed 122 accidents per 1000 men employed. The fatality rate during 1930 at these plants was 1.51 and the injury rate was 105 per thousand men employed. Corresponding reports for the same plants in the preceding year showed a fatality rate of 1.63 and an injury rate of 121. These figures cover all injuries that disabled an employe for more than the remainder of the day on which it occurred.

Conservative figures for 1929 and 1930 for identical plants show that in 1930 there was a reduction of a little over 3% in the number of men employed and a reduction of more than 9% in the total number of manshifts worked. The average working time per employe at these plants was 256 days in 1930 as compared with 274 days in 1929.

Large Cement Plant Planned Near St. George, S. C.

PLANS for a hydro-electric development and the manufacture of cement, on a large scale, near St. George, S. C., from the marble rock of that section, was announced several days ago by State Senator Edgar Brown, of Barnwell, S. C., when he introduced a resolution in the state senate to permit incorporation of the Edisto Power Co., which he said would develop the project.

J. D. Pothro, Aiken, S. C., financier, and S. A. Foster, capitalist of New York and South Carolina, was named as those interested in the project.

Rock Products Clinic

Making Sand from Gravel

TWO RECENT INQUIRIES from widely separated localities ask about the possibilities of crushing gravel to sand.

Several operators have attempted to make sand out of their excess gravel, but none that we know of have succeeded in doing so on a commercial scale in competition with the natural product.

It is comparatively easy to crush limestone to the consistency of sand, and many thousands of tons of limestone screenings, properly washed and graded, are now sold as sand, or fine aggregate. If the gravel pebbles are mostly limestone, therefore, there is no reason why they cannot be made into "sand."

On the other hand, most gravel pebbles are not limestone, but flint, granite, quartz or silica, and in this case it is a costly process to crush them to sand.

Nearly all the other experiments that we know of have used crushing rolls, and rolls are said to be very efficient fine crushers if too much reduction is not attempted in a single pair of rolls.

The difficulty with rolls, as you probably have found out, is the scoring of the shells, and we do not know whether it is possible to make sand by this method economically.

The only other type of crusher that we know has been successfully used to grind gravel pebbles to sand is the Symons disc crusher. The Van Sciver Corp. (now merged with the Warner Co.), Philadelphia, at one time had quite a sizable grinding plant using these Symons disc crushers exclusively, and this was claimed to be quite successful.

The most recent installation for making fine sand from stone that we have heard of is that of the John T. Dyer Quarry Co., whose operation was described in our issue of February 28, pages 47-65. On page 48, "Making Stone Sand for Coal Separation," is described the use of a Lewistown Foundry and Machine Co.'s 9-ft. chaser mill.

This material is trap rock and probably is about as hard to grind as the material that you have, and the fineness of the sand is equal to that described by you.

A chaser mill, as we presume you know, is an old-fashioned type of two grinding discs or wheels which revolve on a horizontal shaft while the shaft revolves simultaneously on a vertical shaft. The grinding is done between the tires of the wheels and a steel ring or pan on which they ride. This type of mill has been used for a great many years for grinding silica rock in eastern silica plants, and apparently still is the most effective grinding device for that purpose, although many others have been tried.

Please Let Us Have Your Experience

WE HAVE given on this page the best answer we can make to two recent inquiries on grinding gravel pebbles to sand—very fine sand in one instance.

We will be mighty glad to publish the suggestions and experience of operators who have tried it, or are doing it. Maybe our suggestions can be much improved upon and elaborated.

Please send us yours.

—The Editors.

Sampling Gravel Deposits

A CONSULTING ENGINEER writes: "I have a client who wishes to test a 160-acre tract for sand and gravel before he purchases same.

"I am not quite certain, however, as to the method which is generally used for testing sand and gravel tracts and I am wondering whether you could give me any information along this line or tell me from whom I might secure same.

"This property is located in the state of M——— where it in no way conflicts with operations of your subscribers."

* * * * *

The Editor's Reply

"There are but two or three practicable methods used for testing sand and gravel deposits, and the method selected depends a good deal on the size of the gravel that is likely to be encountered.

"If there is very little coarse gravel or boulders, a very fair sample of the deposit can be obtained simply by driving down a sharp-edged pipe from 2 to 4 in. in diameter with a simple pile driver at various locations, say at intersections of 100-ft. squares, or even larger cross-sections.

"This, of course, will give you samples of the average in each hole, but will not tell you very much about how the material lies in the deposit. To obtain this information a very good method which has been largely used is to sink a 12-in. cast-iron water pipe or clay sewer pipe by means of excavating the interior with a 10-in. orange-peel bucket. This is a standard piece of equipment and can very easily be rigged up with a tripod over the pipe opening. The pipe is sunk, of course, as the interior is removed with the bucket. In this way a record may be kept of each foot of excavation as you go down.

"Of course, if boulders of 6- or 8-in. size are encountered, the method will not prove satisfactory, and about the only method left is to sink test pits large enough for a man to go into and excavate with a pick and shovel. These, of course, may have to be lined if the excavation is very deep."

* * * * *

Discovery Value of a Gravel Deposit

A PROMINENT consulting engineer who has specialized on income tax matters, but who does not wish his name mentioned here, writes:

"A Louisiana gravel company has been disallowed a discovery claim on the ground that a gravel deposit is not a mine as put forward in the Income Tax Bureau's regulations. The discovery clause refers to a mine but not to a gravel deposit.

"The Sand and Gravel Association secretary appears to be insensible to what it means. They are too busy 'screening their gravel' in that office.

"The above decision was rendered by the Board of Tax Appeals. The case was poorly argued, being the same old story, a lawyer unacquainted with tax procedure, and having no knowledge as to his rights.

"It seems that unless someone takes an appeal from that decision, or another, the finding will be injected into all future cases as indicative of the Treasury Department's stand.

"An appeal to the courts would be desirable because the Board's argument can be applied to stone and other nonmetallics. The fact is the National Crushed Stone and Sand and Gravel Associations should test the ruling. We know that essentially all deposits must be mined with equipment used by mines underground. We know if a deposit is recovered, it is done so by mining; then, if that is the case, why does not the term 'mine' include gravel deposits? Quote your definition for a mine and see how nearly it is on all fours with the movements in a gravel pit. They have held placer deposits were mines, and if there is any difference between a placer deposit and a gravel deposit, I would appreciate being informed on the subject.

"The Utah Copper Co. recovers the product it sells by steam shoveling a mountain. Other natural resources use dragline scrapers. These are all open-cut work, the same as a gravel operation, which has for its benefit steam shovels, as was the case at this gravel company, yet the copper company can claim a discovery if it has one, whereas the gravel company cannot, even though it proves it. The discrimination was never the intendment of Congress. The mistake

appears to be discernible, if not due to a full knowledge of the terms 'mining' and 'mines'."

* * * * *

The Editor's Reply

To which the editor replied:

"I agree with the secretary of the National Sand and Gravel Association that the matter is not of very vital importance to the sand and gravel industry or the stone industry, either, because I think practically all gravel and stone producers are reconciled to the fact that their materials have no intrinsic value and, consequently, no discovery value.

"If you will read the series of articles by Raymond B. Ladoo of the United States Gypsum Co., publication of which was begun in our issue of February 28, you will grasp the point of view of producers in these industries probably better than I can explain it.

"Stone and gravel are so widely distributed that they can be produced almost anywhere, provided one is willing to put in enough equipment for washing, preparation, etc., and their value depends entirely on local markets."

* * * * *

The Engineer's Come-Back

Answering the editor's letter, the engineer-author came back as follows:

"I had an offer of a stone plant recently for $200,000. The plant cost $20,000. This left the quarry with a value of $180,000 on that basis. Do you assume that the new owner would cheerfully pay taxes on his capital asset represented by the $180,000? That is the substance of the statement by yourself and the association. Assuming a tax rate of 10% for the next ten years, this would be $18,000 payable in taxes. Discoveries can be worked in the same way.

"It is not the undeveloped value of a tract being considered. It is the developed value of the tract, developed from all sources, including the market available for the product.

"I grant that a stone quarry in Idaho has no discovery value. I do not grant that a discovery in Pennsylvania has no value. A mine has no value until proved up, neither has a stone quarry more than a nominal value. In every field of natural resource development the same economic principles must be applied. In one there is value, and in another none, etc. We have known this for a thousand centuries."

* * * * *

Small Sand-Settling Box

FROM Calgary, Alberta, Canada, came the following:

"I have been a subscriber to your magazine Rock Products for some time past, and some time ago you sent me a copy of your publication entitled 'Sand Settling and Devices for Settling and Classifying Sand.' In this book, on page 15, there is an article by Edmund Shaw, contributing editor of Rock Products, on calculating a surface current settling box.

"My plant as erected used a small sand box and a flume to carry away the water; the box was much too small and I have been losing the fine material, owing to the sand box being too small.

"A sieve analysis of the sand from my plant shows there is too much sand retained on the No. 4 sieve and not enough on the Nos. 8, 16, 30, 50 and 100 sieves. In your publication you invite subscribers to send their problems to you.

"I have room on top of the bins for a box 3 ft. 10 in. wide outside measurements and 20 ft. long, discharging into a 12-ft. by 12-ft. bin. The height as given to screen is 11 ft. 6 in. The minimum output of the pump is 180 gal. per min. and the output of gravel and sand is 300 tons per day.

"Would you please give me correct size settling bin to install under shaker screen in the space available that will result in my retaining the correct sized grades for a concrete sand that will fill the A. S. T. M. specifications? My solids are taken direct from the bed of a river about 60 to 80 miles from the mountains, and consist of a fairly clean sand and gravel mixture, in the proportions of 75% gravel and 25% sand. There is quite a little fine material in this combination, with a little clay silt.

"In designing settling bin, would it be possible to have a sloping bottom so that all sand would run out into the 12-ft. by 12-ft. bin?"

* * * * *

Editor Shaw's Answer

"It seems to me the only difficulty you have comes from too small a sand box. The amount of water you mentioned, 125 gal. per min., is smaller than I have been used to handling, but I would say that a box 10 ft. long and 3 ft. wide and 4 ft. deep ought to catch all of the sand. At least it figures out that way.

"You say that the sand shows too much retained on No. 4 and not enough on the smaller sizes. That might mean that too much was being washed over or it might mean that the new material might have been more on No. 4 than was wanted for good grading. In that case I would advise you to put in a box with the dimensions just given, with two partitions which should not come up to the top of the water. This will make a box with these equal compartments. Then have an outlet in each compartment. That will give you three products. The first will be very coarse, the second will be medium and the third fine. You can arrange to split off part of the coarse product and throw it away. I worked with a box of this kind last summer under very difficult conditions, having sometimes to throw away a lot of fine and other times a lot of coarse, but it gave me a great deal of satisfaction. However, I would not advise its use unless you find that the difficulty is with the raw material and not with the sand box.

"I have examined the sketch of your layout and I do not see any reason why you could not arrange the sand box so that a discharge would flow into the 12x12-ft. bin, provided there is headroom enough. You have not given the height of the 12x12-ft. bin, but if the sides came up too far you could always run a spout in through a side. There is no objection to making the box with a V-section or a sloping bottom. I think the sloping bottom is not quite so good as the V-section.

"With a box of this kind the important thing is to keep it pretty well filled up with settled sand. If you will get the right size opening for each discharge the box will stay full of sand and will not need any attention. In your case the trouble would be that the quantity is so small that the opening would be apt to choke occasionally, but that is something you will have to work out as best you can.

"If anything in this is not clear or you think I could be of any further assistance in this matter, please write me."

* * * * *

The Fineness Modulus

A SUBSCRIBER in Oslo, Norway, asks for an explanation of the "fineness modulus" for expressing the sieve analysis of sand and gravel. Here's the answer:

The fineness modulus is the sum of the percentages in the sieve analysis of the aggregate divided by 100. The sieve analysis is determined by using the following sieves from the Tyler Series: 100, 48, 28, 14, 8, 4, ⅜, ¾ and 1½-in. mesh. By using the above series each sieve has a clear width of opening just double that of the next finer sieve. In the following table the sieve analysis and fineness modulus of several concrete aggregates are shown. The sieve analysis is expressed in terms of the percentage of material by weight coarser than each sieve.

METHOD OF CALCULATING FINENESS MODULUS

	Per cent. of sample coarser than a given sieve			
Sieve size	A	B	C	D
100-mesh	91	100	100	98
48-mesh	70	100	100	92
28-mesh	46	100	100	86
14-mesh	24	100	100	81
8-mesh	10	100	100	78
4-mesh	0	95	100	71
⅜-in.	0	66	86	49
¾-in.	0	25	50	19
1½-in.	0	0	0	0
Fineness modulus	2.41	6.86	7.36	5.74

Ordinance Restricting Ready-Mixed Concrete Withdrawn

COMMISSIONER CLYDE R. MAY, St. Paul, Minn., on April 15 withdrew from before the council an amending ordinance providing restrictions on ready-mixed concrete and increasing building permit fees approximately 100%.

Provisions of the amending ordinance would have restricted use of ready-mixed concrete to that made in mixing plants within the city limits.—*St. Paul* (Minn.) *News.*

Foreign Abstracts and Patent Review

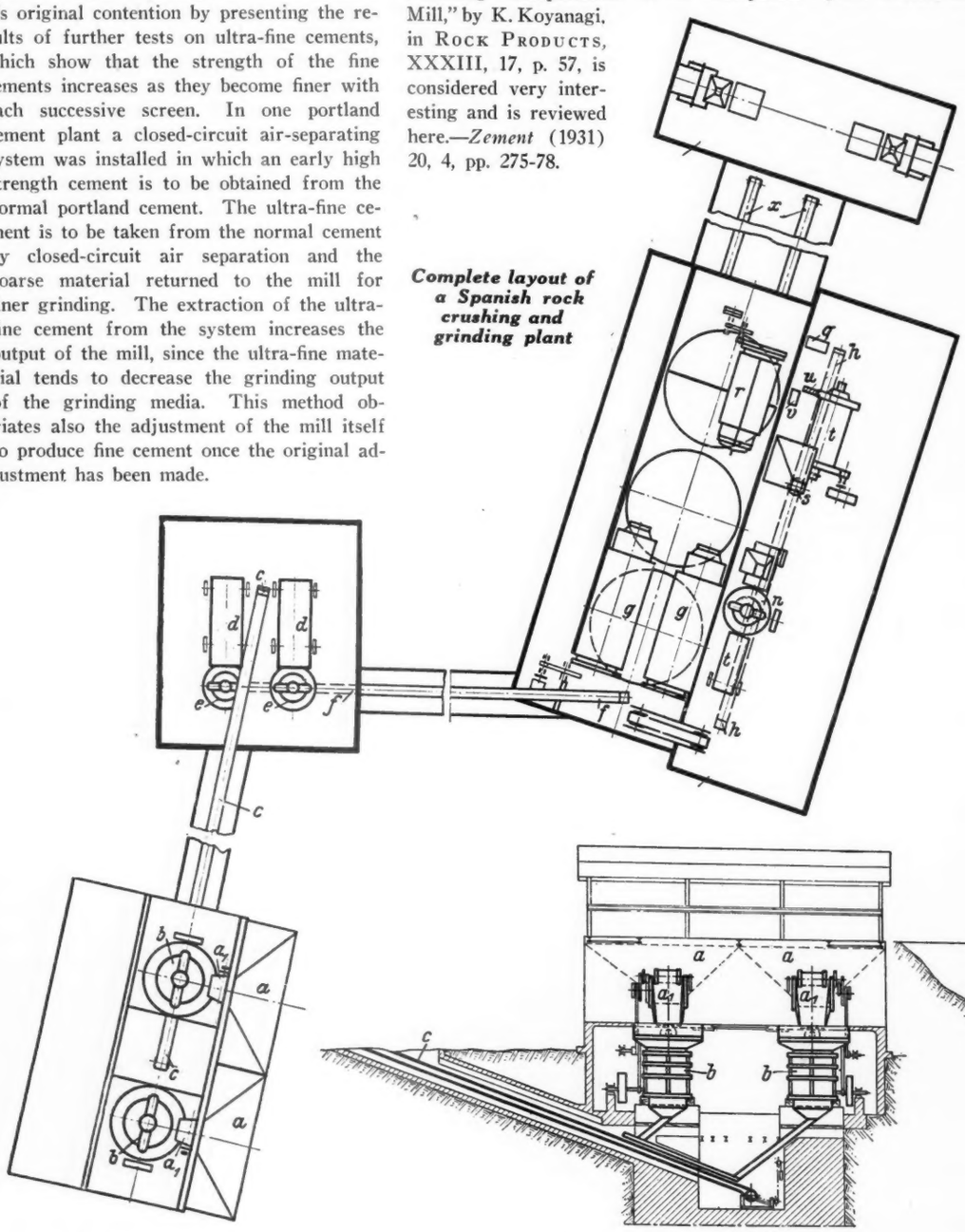
Strengths and the Fine Grinding of Cement. A. B. Helbig states he contended last year that only economic reasons limit the fine grinding of cement and that the finer a cement is ground the higher will be its strength, especially in short period tests. He meets the contradictory results of the investigations of Kuehl and A. Hauenschild with the explanation that the very small quantities of ultra-fine cement are, in air separation, partly set on account of the moisture in the air and result therefore in lower strength. Helbig then substantiates his original contention by presenting the results of further tests on ultra-fine cements, which show that the strength of the fine cements increases as they become finer with each successive screen. In one portland cement plant a closed-circuit air-separating system was installed in which an early high strength cement is to be obtained from the normal portland cement. The ultra-fine cement is to be taken from the normal cement by closed-circuit air separation and the coarse material returned to the mill for finer grinding. The extraction of the ultra-fine cement from the system increases the output of the mill, since the ultra-fine material tends to decrease the grinding output of the grinding media. This method obviates also the adjustment of the mill itself to produce fine cement once the original adjustment has been made.

The author then discusses the nature of operation of the grinding media, in which reference is made also to an article, "Raw Grinding and Slurry Control in Portland Cement Manufacture," by R. J. Binford in Rock Products, XXXIII, 16, p. 41, the statements in which relative to the relation of size of grinding media to the maximum granular size of the charged material conform quite well with the experiences of Helbig. The article on "Comparison of Balls and Cylpebs as Grinding Media in the Finishing Compartment of a Compound Mill," by K. Koyanagi, in Rock Products, XXXIII, 17, p. 57, is considered very interesting and is reviewed here.—*Zement* (1931) 20, 4, pp. 275-78.

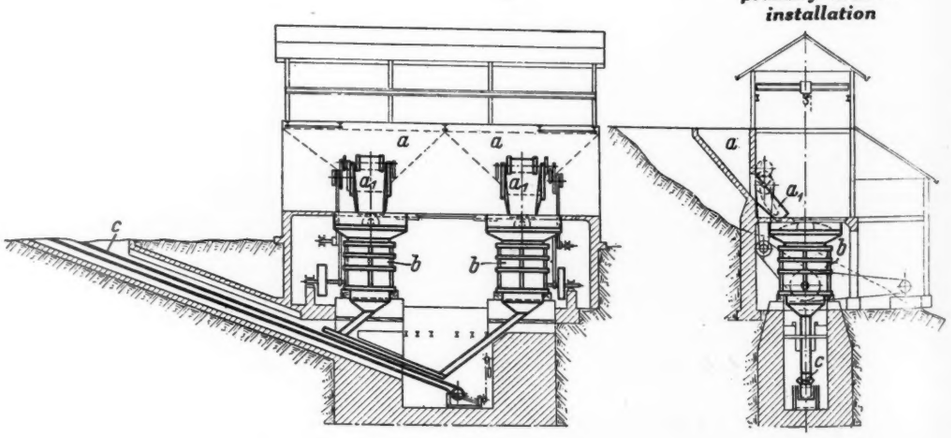
Rock Crushing and Grinding Plant. The Humboldt Machinebuilding Plant at Koeln-Kalk has supplied the crushing and grinding plant for preparing all the aggregates to be used in building the Esla dam in the province of Tamora, Spain, which requires 360,000 cu. m. of concrete. This plant has a handling capacity of about 300 metric tons of granite per hour, handling granite pieces up to 1 ton in weight. The installation is described and illustrated in detail.

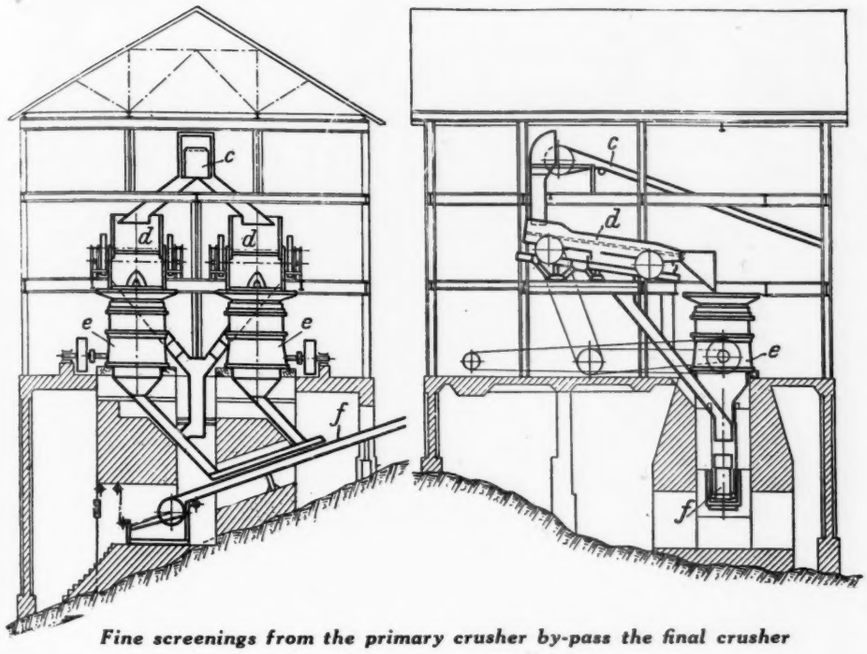
[The accompanying sectional views of the plant indicate an unusually compact arrangement. It will be noted that two primary crushers are used, an arrangement very seldom met with in this country. Each crusher is fed by a chain feeder from the raw material bunkers, the coarse crushed material then being carried by belt conveyor to inclined shaking screens for scalping, from which the oversize falls to two secondary gyratory crushers. This recrushed material, as well as the fine material passing through the screens, is then carried by belt conveyor to two rotary screens for final screening. In order to make fine material, other equipment is used as indicated, including a fine reduction crusher, double crushing rolls and a ball mill in connection with enclosed bucket elevators, feeders, etc. The following sched-

Complete layout of a Spanish rock crushing and grinding plant



Below—Details of primary crusher installation





Fine screenings from the primary crusher by-pass the final crusher

ule identifies the units in the plant.—The Editor.]

a—two bunkers.
a¹—two chain feeders.
b—two gyratory crushers (primary).
c—belt conveyor from primary crusher.
d—two double-deck shaker screens.
e—two gyratory crushers (final).
f—belt conveyor to final screen house.
g—two rotary screens.
h—belt conveyors.
i—feeder.
k—bucket elevator.
l—shaking screen.
m—two-roll crushers.
n—fine reduction crushers.
o—shaking screen.
p—reciprocating feeder.
q—vertical bucket elevator.
r—rotary screen (hexagonal).
s—table feeder to ball mill.
t—ball mill.
u—screw conveyor from ball mill to elevator.
v—vertical bucket elevator.
w—four feeders.
x—two belt conveyors.
y—four discharging plates.

Zeitschrift des Vereines Deutscher Ingenieure (1930) **74**, 35, pp. 1211-1214.

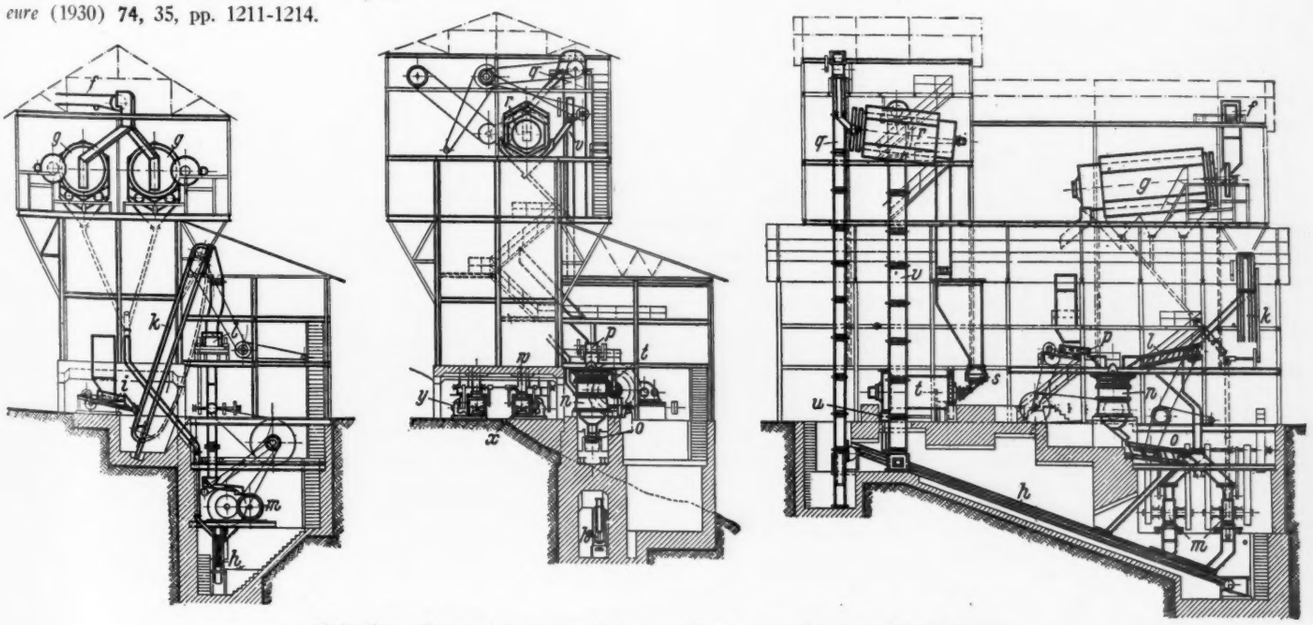
Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Commissioner of Patents, Washington, D. C., for each patent desired.

Acoustical Material. The patentees describe an acoustical tile of pleasing appearance and methods of manufacturing it. They propose to use a mineral wool with starch gel as a binder. Karaya gum or Tragacanth gum, on account of their abilities to absorb large quantities of water and form a syrupy but not sticky solution, is added to give plasticity to the mix. Blood albumin or animal glue and copper sulphate are added as a water resistor and pyrophyllite as a mineral filler to reduce the tendency of the binder to smoulder on burning. Pyrophyllite is a hydrated aluminum silicate belonging to the kaolin division and is preferred on account of its large bulk. A preservative such as beta naphthol or alpha naphthylamine and coloring matter such as raw sienna or iron oxide pigments can be added. Details as to mixing, molding, drying and finishing are described—*George D. King and Roger H. Stitt, assignors to the United States Gypsum Co., U. S. Patent No.* 1,769,519.

Magnesite Insulating Wallboard. The patentees prepare a wallboard consisting of shavings, straw, rushes or other vegetable material using magnesite as a binder. Special perforated molds are used to allow the excess binder solution to drain away and to further assist in the drying out of the board.—*Rudolf Karg and Josef Weiss, U. S. Patent No.* 1,752,561.

Air Separator. A new form of the well-known Sturtevant air separator has been patented embodying several improvements in construction. The principal improvement covered in the claims seems to be the arrangement of the vanes through which the circulating air passes. These vanes, as in other types of this separator, give the air a rotating motion imparting the centrifugal force which causes the separation. In the device patented the vanes overlapping flanges above that prevents grains passing between them. The location of the vanes is such there can be no accumulation of material where the air current enters the vanes. The whole arrangement is such that it promotes a smooth, easy flow of the air current through the settling and separating chambers and also, according to the claims, it prevents escape of dust between vanes.—*T. J. Sturtevant, U. S. Patent No.* 1,769,721.



Grinding plant with roll and fine reduction crushers and ball mill

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Permanent Exhibit of Decorative Concrete

THE C. T. Raule Co., contractor for concrete work and designer of beautiful ornamental pieces in concrete, at Los Angeles, Calif., has found it advantageous to maintain a permanent exhibit of concrete pieces, chiefly garden pieces, in the Building Arts and Crafts Exhibit in that city.

The advantages of such an exhibit are numerous, it is thought by these contractors. In the first place the public needs educating in the matter of the beauty of concrete pieces when properly made; so by placing such articles where the greatest number of home owners and prospective builders will see them the more rapidly will the public become aware of the advantage of concrete in ornamental pieces.

Los Angeles manufacturer of art concrete has permanent display at Art and Crafts Exhibit

Exhibit Makes Direct Appeal

In the second place it is maintained that the average person visiting such exhibit is "home minded" and "building minded" when he goes and so is susceptible to impressions, in other words the exhibit is making a direct appeal to a person who presumably is willing to learn.

In the third place, in an exhibit building like the Building Arts and Crafts Building, the visitor is shown about by an experienced host or hostess, one capable of presenting the merit of such exhibit to the visitor.

In the fourth place, the cost is proportionately small and the number of people viewing the exhibit is large. For instance, between twelve and fifteen thousand people passed through the building in one week in the month of March, and a great variety of activities are kept up in the building in order to increase attendance. It would be impossible for a concrete products manufacturer to attract any such number of people to his place of business were he acting independently.

In the fifth place, the concrete pieces are shown in the best possible surroundings, the entire building being fitted out artistically.

The system in this particular exhibit building is decidedly to the advantage of the exhibitor. When a visitor expresses interest in an exhibit he is asked cordially to leave his name, providing he would like to have a representative of the exhibitor call upon him. Leads of this kind are found to be "live" in a greater proportion than leads secured in almost any other way.

Co-operation from Management

R. C. Symonds, manager of the exhibit building, has had considerable experience in his line of work and in addition to showing the individual exhibits he makes it a part of his business to create a co-operative spirit among his exhibitors. Any concrete products man will realize the value of co-operation with men in other lines of building or home furnishing activity.

Exclusive privileges in showing such concrete art pieces are guaranteed the exhibitor.

To the advantages stated above it might be added that an exhibit building of this kind naturally achieves a reputation as a place where *new ideas* in building and equipping homes can be found. New ideas naturally enough center in such exhibits. The Los Angeles exhibit building has purposely been located in a very fine neighborhood business district, adjacent to one of the finest residential districts in the United States—the Wilshire district.

To Cement Off Oil Wells

A PATENT HAS BEEN granted Richard Buhman on a cement for cementing off oil wells, etc. This patent provides that a usual cement mix is treated with $CaCl_2$ to serve as a dehydrating agent and with $FeCl_3$ which will react with the cement to form additional $CaCl_2$ and a hydroxide which acts as an initial set-retarding agent.—*Chemical Abstracts.*

A Comparison of Control Factors*

The Wet Plant and Dry Plant Systems of Making and Delivering Ready-Mixed Concrete from the Standpoint of Control

By Fred C. Wilcox
Pelham Manor, N. Y.

MOST OF THE FACTORS entering into the problem of control in the manufacture and delivery of ready-mixed concrete are identically the same, or can be set up on essentially the same basis, in either the *wet plant* or the *dry plant* system. These two systems are both central plant systems, and are defined as follows in the "Specifications for Ready-Mixed Concrete" adopted by the American Concrete Institute at its annual meeting in Milwaukee in February, 1931:

Wet plant system: "Central-plant-mixed concrete."

Dry plant system: "Central-plant-proportioned-truck-mixed concrete."

This is the first working specification for ready-mixed concrete framed by any American engineering or other similar society, and it recommends that in general both systems of producing ready-mixed concrete be included by architects and engineers in their job specifications.

A. C. I. Committee 602 on "Design and Operation of Central Concrete Plants" in its report presented at the same time recognizes both methods of operation on the same basis from the standpoint of control.

Factors in making and delivering ready-mixed concrete which can be controlled on practically the same basis in the *central-plant-mixed* and *truck-mixed* methods are as follows:

I—Proportioning and Water Control

(1) Measurement of materials by weight. Identically the same in either system.

(2) Gradation of materials, including the handling of separated sizes of aggregates (now required on paving work in some states including New Jersey, New York, Wisconsin, Arkansas and Texas). Identically the same in either system.

(3) In either method of operation, control of mixing water can be handled in exactly the same manner, that is, by means of an automatic water measuring tank located in either the central mixing plant or the central proportioning plant. Water control also includes determination of moisture content of aggregates, for making corrections in the amount of added mixing water, and this control is identically the same in either system. Compensating for loss of water in transit due to absorption and evaporation can also be controlled in a like manner in either type plant, that is, by adding the correct amount of water at the central plant to give the desired water-cement ratio when the concrete is finally placed.

II—Mixing and Agitating

(4) The *wet plant* operation involves premixing the batch in a central plant mixer and *continuing to mix* or, as it is termed in this case, *agitate* the mixed batch on the way to the job. In the *dry plant* system of operation the batch is mixed in truck mixers on the way to the job, or at the job. In each operation the problem of control is the same: First, to secure a thorough mix and, second, to keep the mixed concrete properly agitated and prevent segregation until it is finally delivered and deposited.

There are truck mixers which have the same drum design and mixing action as standard mixers and pavers, these machines having drums of "low length-diameter ratio" (relatively short in length in proportion to diameter), and drum blading of practically standard design. In truck mixer units of this type the mixing action differs in only one respect (with no difference in result) from that of standard mixers and pavers, namely, the truck mixer drum is revolved at a slower speed and therefore a longer *minimum mixing time* is required.

Units which do not "agitate" properly will not prevent segregation of high slump (wet) mixtures. On the other hand, units which will satisfactorily agitate concrete of all consistencies employ essentially a standard mixing drum action, usually at a slow speed.

When concrete is mixed either in transit or at the job in truck mixer units of this design, there is no essential difference between the *wet plant* and *dry plant* systems in respect to the mixing process.

(5) Length of mixing time can be controlled in identically the same manner in truck mixers as in central plant mixers, namely, by means of a batchmeter on the central plant mixer or on each truck mixer.

III—Transporting and Placing Concrete

(6) Proper agitation of the mixed concrete is necessary in preventing segregation of the batch while hauling and discharging it. Since good mixing action and good agitating action are essentially the same, here again the problem of control is practically the same in either type plant. In other words, the transportation and delivery of premixed or truckmixed concrete in a satisfactory manner depend in each case almost entirely on the use of mixing or agitating units that will deliver and discharge the batch in the desired condition of uniformity and workability with the least amount of separation of the mixed aggregates.

(7) Elapsed time between mixing and placing is subject to practically the same control in either the *wet plant* or *dry plant* method of manufacture. This control in either case may be by limiting the length of haul or the hauling time; and when the concrete is mixed in truck mixers in transit to the job or at the job, an additional control of elapsed time between mixing and placing may be secured by means of a batch timer on each truck mixer.

IV—Central Plant Inspection and Job Inspection

(8) With the exception of *mixing time* (Items 4 and 5 cover the control of this factor), inspection of all central plant operations involved in the manufacture of ready-mixed concrete may be set up on identically the same basis in either the *central mixing plant* or the *central proportioning plant.*

(9) There is no essential difference between the *premixing system* and the *truck-mixing system* from the standpoint of job inspection. In either method of operation the consistency of the batch may be checked before the concrete is finally placed.

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Chert Gravel as Sewage Filter Stone

"CHERT GRAVEL will probably give satisfactory results in that part of a filter more than 3 ft. from the surface of the bed, but does not appear to offer great possibilities as a surface stone for trickling filters," says J. E. Lamar in an article for *Sewage Works Journal.* It will also support a good biological growth and is not materially affected by solution.

These tentative conclusions were arrived at after investigations and tests extending over a five year period. He also says these conclusions do not apply to chert generally but rather to natural chert stream gravel which has undergone weathering and abrasive processes that have eliminated the less resistant material.

Ed. Shaw's News Letter From Los Angeles

WHEN ONE is writing letters for publication it is unpleasant to have to tell the truth about unsatisfactory conditions. But the truth is that so far as the rock products industry is concerned, in spite of the columns of newspaper print that have told of signs of returning prosperity, things continue to be as they were. Aggregate production, which I take to be the great barometer of construction for this part of the country, remains, as it has for months, at a little more than half of what was once considered the normal tonnage. By the time this is printed, conditions may be better, but just now the big jobs are all in the future.

The worst feature of the situation is that a strong effort is being made to convince people that they have gone too far with public works. If only Los Angeles were affected by such a sentiment the matter would not be worth writing about to a magazine of national circulation. But what I hear from other places leads me to believe that the same condition exists in many parts of the United States and that the construction industry is suffering from it.

* * * * *

The Wrong Time to Economize on Public Works

Here, after having voted several millions in bonds to relieve unemployment, people seem disposed to shut down on any kind of expenditure. Really needed improvements have been held up because special assessments did not carry. That is quite understandable. Everyone agrees that the special assessment situation is a mess, and overlapping assessments in some cases amount to the full value of the property. A bill now before the California legislature restricting assessments to one-half the value of the property seems to be badly needed legislation.

But there is also opposition to improvements for which no special assessments are required. Their opponents are pointing out that both city and county are living way beyond their incomes and they demand retrenchment. Presumably this demand for curbing expenditure is what has caused the *Los Angeles Times* to print a series of articles which give definite figures of income and outgo. They show plainly that the city and county take in much less than they spend. But they do not show that the money that has gone into construction is responsible for this.

Pavements, bridges, sewers, tunnels; these are things the taxpayer can see, and he thinks of them first when he wonders where the money has gone. But an analysis of the county's expenditure shows that only a small part of the money has gone into these really tangible and permanent things.

The city's figures are too hard for anyone but an expert to analyze because it is so heavily in business, with its Department of Water and Power and its docks and other income producing property. But no such difficulty exists with the county figures, which are equally significant.

* * * * *

Where Los Angeles County's Money Goes

These show that in the decade, 1920-1930, the county's population increased 135.84%. Meanwhile assessed valuation increased 253.86%. But taxes increased 421.44% and *the cost of government increased* 427.62%. And since a deficit had to be made up, the bonded indebtedness increased 395.16%.

In 1930, the county spent $125,385,652.40, of which only about $96,000,000 was raised by taxation. For simplicity I have figured the amounts spent for various purposes as percentages of the whole. They are: Schools, 50.3%; general government, 7.9%; protection to persons and property, 4.7%; highways and bridges, 8.8%; charity, hospitals and correction, 10.6%; health, sanitation and recreation, 7.0%; county bonds and interest, 3.7%; school bonds and interest, 7.0%.

Note that 50.3% plus 7.0% or 57.3% of the whole went for schools and school bonds. In the city, in 1930, the tax rate was $4.26 per $100. In the unincorporated county districts the base rate was 88 c. per $100. But in addition there was a tax of 5 c. for free libraries, 10 c. for flood control, 20 c. for road tax and a school district tax ranging from $1.19 to $2.57, depending on where you lived.

* * * * *

Too Much for "Education"

I am strong for education, but it looks to me like overdoing it to spend almost 60 c. out of every dollar of income for it at a time when the county is running heavily in debt. The percentage for charity, hospitals and correction (10.6%, which is $13,000,000) appears plenty large when one considers that it is in addition to the immense sums spent by the Community Chest and other organized charities, and also in addition to the pensions that keep the old and incapacitated employes of some companies from becoming a public charge. Looking the figures through, the 8.8% spent for highways and bridges appears pretty small, especially when one remembers that this money is really an investment that gives quick and large returns in cheaper transportation, longer car life and increased property values. And through gasoline and vehicle taxes it produces the revenue for maintenance and more.

In the items of bonded indebtedness, the only one that I find charged wholly for construction is $6,279,000 spent for macadam roads, farm and hospital buildings and the Hall of Justice.

* * * * *

Amount Spent for Public Improvements Not Disproportionate

I know enough of other places to know Los Angeles is not the only city which has spent a lot of money for public services and improvements. I am not saying that it has been well spent or ill spent. But I believe that in every case an analysis of the figures will show that the amount spent on roads, bridges, public buildings and the like has not been disproportionate, especially when one considers the permanent and revenue producing nature of such improvements. And they are needed in our fast growing cities. In spite of all that has been spent, there is many an antiquated public building adding to the cost of public business and many a narrow bridge and bad crossing that is costing heavily in lost time and accidents.

* * * * *

Some Construction Work in Prospect

Of the big jobs coming in the future, one thinks of Boulder Dam first, but the canal which will bring the water here will cost several millions more. Then there is the All-American canal to bring 10,000 sec. ft. of water from the Colorado to Imperial and Coachella valleys, to cost at least $33,000,000. The morning paper mentions that bids have been opened for a viaduct to cost $1,400,000 and a tunnel to cost $182,000, here in the city, and that the city and county have agreed with the railroads on a plan of eliminating grade crossings which will cost $5,000,000.

The $5,000,000 bond issue recently passed as a relief for unemployment is being spent. A lot of it is going into community houses, tennis courts and swimming and wading pools in public playgrounds and parks. They are welcome improvements. A barren playground in my neighborhood is being converted into a real asset to the locality. Highway contracts amounting to $4,732,000 have been let this month.

There are many less men looking for jobs, one reason being that about 40,000 Mexicans have left the city in the past few weeks. The raids of the federal authorities for deporting aliens unlawfully in the country, it is reported, have scared them out. Many of them were employed in rock products plants, but their places were promptly filled.

Ohio Marble Co. Organizes Subsidiary

ANNOUNCEMENT HAS been made of the organization of the Piqua Stone Products Co., a subsidiary of the Ohio Marble Co. The new organization will become the sales agency for the latter company and will place upon the market the output of the local quarries, specializing in stone for all purposes.

The same officers who direct the affairs of the Ohio Marble Co. are also the officers of the subsidiary company. These officers are as follows: Mrs. M. F. Hall, president; A. Acton Hall, vice-president and general manager; George W. Berry, secretary and treasurer; F. J. Heinritz, assistant secretary-treasurer. In addition to the above officers these two directors have been named, John Decker and Warren S. Gravett.

The Pearl Grit Corp., another subsidiary of the Ohio Marble Co., will continue to direct the sales of "Pearl" chicken grit and its sales will be enlarged.

The company has announced that the state highway department recently conducted a test of a new stone ledge at the quarry and this stone was found to meet the requirements for highway work and will be used for road construction in the future.

The company is also announcing its readiness to supply stone for decorative effects for houses and for beautifying gardens. Flagstones of attractive designs and colors may now be had for these purposes.—*Piqua* (Ohio) *Call.*

New Gravel Pits Opened in Nebraska

THE SCHELLBERG SAND AND GRAVEL CO., Omaha, Neb., is opening sand and gravel pits on the 130-acre tract of land purchased from W. J. Courtright last summer. This is a part of what was the Golden Rod creamery farm and lies south of the Union Pacific railroad just west of the city.

A siding connected with the U. P. is being built 150 ft. west of the Burlington crossing and will be 4,400 ft. long. Walter Van Gerpin has the contract for two gravel bins and the boats to be used as equipment for pumping. Edward Lyddon is looking after the work for the company.—*Tremont* (Neb.) *Tribune.*

City Seeks New Gravel Pits

WITH THE SUPPLY of city gravel nearly exhausted, City Engineer Charles H. Armstrong and the street and alley committee prepared to start a search for sites for a pit on April 21.

The action was authorized by the city council.

At present, Mr. Armstrong said, the city is using the Waldron pit on old Highway 20 northwest of the city, and he doubts if there are more than 2500 cu. yd. of gravel left.

A new source of gravel is expected to be necessary for the city's street and improvement program.

Mr. Armstrong and the street and alley committee, whose chairman is Alderman Fred W. Miller, also were authorized to make tests of sites that apparently are favorable.—*Rochester* (Minn.) *Post.*

President "Al" Worthen Attends New York State Stone Meeting

A LIVELY and interesting meeting of the New York State Crushed Stone Association was held in Rochester, N. Y., May 1. A. L. Worthen, president of the National Crushed Stone Association, paid his first visit to the New York Association and was enthusiastically received. Mr. Worthen addressed the meeting, mentioning some of the activities of the national organization, and complimented the New York members for their loyal co-operation. He also spoke of the necessity for broadening the research work under Engineer Goldbeck at Washington. The members thanked Mr. Worthen for his visit and invited him to attend as many future meetings as possible.

Standard Sales Contract

John Rice, Jr., chairman of the committee to investigate a standard form of sales contract, discussed this topic at some length and expressed the hope that the association would recognize its value. After comment by various members, James Savage moved that the association express its approval of the sales contract form and recommend its use by all producers. The resolution was carried, after which Mr. Graves suggested that the secretary canvass the meeting for an expression of the members agreeing to use the form. This canvass developed that five firms would adopt the form. The secretary was then instructed to communicate with absent members in relation to their use of the contract.

"Joint Association" No Nearer

The committee of the association which met with a like committee of the Empire State Sand and Gravel Association, regarding reasons for a possible consolidation of the two organizations, did not offer a report, but discussed the subject as individuals. Chief among those participating in this discussion were O. M. Graves, of the General Crushed Stone Co., and H. V. Owens of the Eastern Rock Products, Inc. The committee was subsequently dismissed, with thanks.

President A. S. Owens then spoke of the new stone sizes for 1931 and the necessity for proper interpretations to conform with specifications. This matter was discussed at length, after which A. G. Seitz offered a resolution, seconded by H. J. Russell, that it be placed in the hands of a committee. Upon approval of the motion, President Owens appointed a committee composed of F. C. Owens, of Syracuse, A. J. Hooker, of Buffalo, and B. P. Babcock, of Albany, to act for the association.

Attendance

B. P. Babcock, Callanan Road Improvement Co., Albany, N. Y.
W. E. Foote, Wickwire Spencer Steel Corp., Gasport, N. Y.
James Savage, A. L. Hooker, Buffalo Crushed Stone Co., Buffalo, N. Y.
D. L. Moore, Frank Howe, Duane Moore, Le Roy Lime and Crushed Stone Corp., Le Roy, N. Y.
O. M. Graves, John Rice, Jr., General Crushed Stone Co., Easton, Penn.
A. G. Seitz, F. C. Owens, F. F. McLaughlin, General Crushed Stone Co., Syracuse, N. Y.
F. W. Schmidt, North Jersey Quarry Co., Morristown, N. J.
C. S. Wicker, Federal Stone Co., Buffalo, N. Y.
H. J. Russell, Jointa Lime Co., Glens Falls, N. Y.
A. S. Owens, Harold V. Owens, Eastern Rock Products, Inc., Utica, N. Y.
George E. Schaefer, General Crushed Stone Co., Rochester, N. Y.
A. L. Worthen, president, National Crushed Stone Association, New Haven, Conn.
George E. Merchants, B. R. & P. Railway Co., Rochester, N. Y.
Wm. A. Anderson, Hercules Powder Co., Buffalo, N. Y.

West Coast Cement Project

ANNOUNCEMENT of the executive personnel of San Jose Cement Co., Ltd., recently formed in Dover, Del., with authorized capital of more than $19,000,000, is expected soon, says the West Coast edition of the *Wall Street Journal.*

While officials have been reticent as to information as to the company's future operations, it is understood that its formation does not foreshadow the consolidation of any large units in the California cement industry, although the Port Stockton Cement Co. has been mentioned as a possible affiliate. It is believed in local (San Francisco) cement circles that the concern will undertake the exploitation of limestone deposits in the Santa Clara valley.

Penn-Dixie Men in an Automobile Accident

FIVE MEN RETURNING HOME from the Portland Cement Association safety meeting in Albany, N. Y., were injured April 16 when their automobile ran down an embankment at Dunnsville, on the Western Turnpike, three miles west of Sharpe's Corners.

Clifford Dickerson, of Ludlowville, was the most seriously injured. He is in Ellis Hospital, Schenectady, with a fractured skull and numerous other injuries.

Others injured were: Kenneth Ford, Atwater, N. Y., injuries to the right side and possible fractured arm. David Fortunin, Ithaca, bruises. Floyd Warner, Ithaca, bruises. Mettis Wolf, Ludlowville, bruises.

The latter three were able to leave Ellis Hospital after being treated. The five men are all employed at the Portland Point plant of the Pennsylvania-Divie Cement Corp.

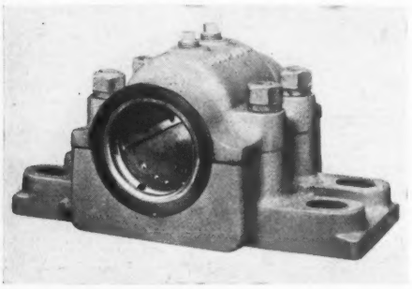
Mr. Fortunin is the son of Morris Fortunin, general manager of the Pennsylvania-Dixie Cement Corp., Ithaca, who was toastmaster at the convention in Albany. Floyd Warner is the superintendent of the same council, which has had the matter under attention for some time.

New Machinery and Equipment

Anti-Friction Bearings

THE Robins Conveying Belt Co., New York City, announces the Robins-Jones bearing which it now manufactures and sells. It is claimed this bearing furnishes a constant and uniform microscopic film of oil between the shaft and the bearing metal. The manufacturer says there is no oil leakage, also that low oil consumption is obtained as a result of the automatic circulating system provided in the bearing.

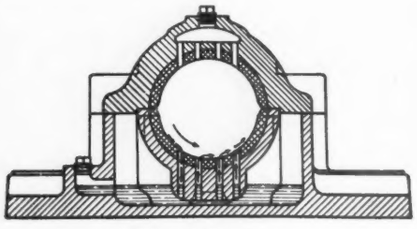
An oil reservoir in the base supplies lubrication through a series of ducts in the bearing metal. Rotation of the shaft



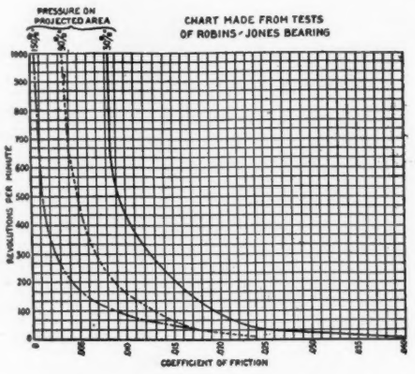
Showing end grooves and distribution of oil ducts

draws oil from this reservoir through these ducts to the point of greatest pressure on the bearing. From this line, it is said, oil is spread uniformly over the whole shaft. At the parting of the cap and base scavenger holes in slots return excess oil to the reservoir. Grooves near each end of the bearing prevent leakage and leads oil that works out to the ends back into the reservoir.

This bearing permits shaft rotation in either direction, so that it may be used for hoists, sheaves and other heavy or light machinery operated alternately in both directions. The manufacturers say this bearing may be applied to both horizontal and vertical shafts. It can take a load or pressure from any direction, since the cap is built on the same principle as the base.



Arrows indicate direction of oil flow


PRESSURE ON PROJECTED AREA
CHART MADE FROM TESTS OF ROBINS-JONES BEARING
REVOLUTIONS PER MINUTE
COEFFICIENT OF FRICTION

Showing friction under various operating conditions

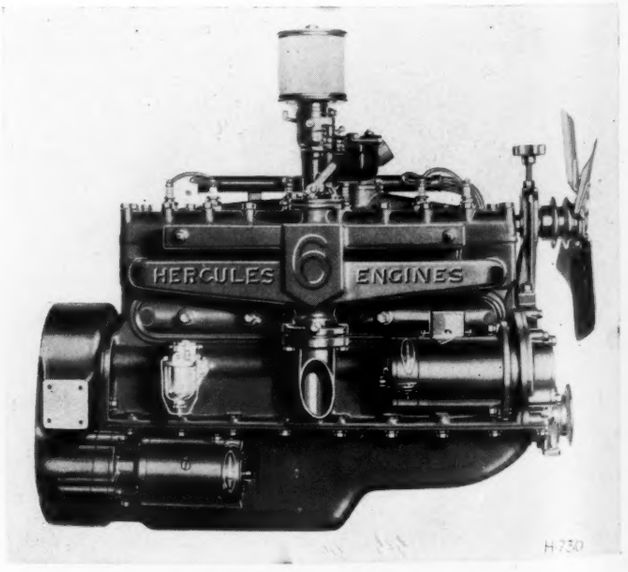
The Robins-Jones bearing is split so the lower liner may be rotated around the shaft in removing it. The base is flat underneath. Base and cap are machined where they come together and ends are faced.

According to the manufacturer the range of speed to which this bearing is adaptable varies from 1 r.p.m. to 5000 r.p.m.

Small Heavy-Duty Sixes

THE HERCULES MOTORS CORP., Canton, Ohio, is offering an additional line of heavy-duty, 6-cylinder "L" head engines designated as series "JX." Three sizes are offered. A 7-bearing crankshaft is used, all 2½ in. in diameter. The crankcase is cast integral with the cylinder block. Connecting rods are drop forged. Bearing material is cast into the rod, as well as in the drop forged caps. Lubrication of main and connecting rod bearings is by gear pump. Either downdraft or updraft intake manifolds can be furnished. Exhaust manifolds of center or rear outlet type are also optional. Either three or four point suspension is available.

The manufacturer says the horsepower and torque of all engines in this series makes them suitable for commercial cars of ¾- to 1½-ton capacity, and other heavy-duty uses wrere low speed torque and, at times, rather high engine speed performance are necessary. The horsepower of all three sizes "peaks" at between 3000 and 3100 r.p.m.



A new line of six-cylinder "L" head gasoline engines

Insulated Aluminum Wires and Cables

INSULATED aluminum wires and cables are being offered by the General Cable Corp., New York City, under the trade name of "Alectral."

According to the manufacturers, certain favorable characteristics of aluminum recommend its adoption as advantageous to the user in specific applications where these characteristics, in combination with installed costs, show definite superiority, and to meet this need the company's research department has developed "Alectral."

The following table of comparisons is given to demonstrate the advantages of insulated aluminum wires and cables:

TABLE OF COMPARISONS

	Aluminum	Copper
Conductivity, hard drawn, % annealed copper std.	61	97
Conductivity, annealed, % annealed copper std.	62	98.2
Relative conductivity, equal volume	0.63	1.000
Relative volume, equal conductivity	1.59	1.000
Relative diameter, equal conductivity	1.26	1.000
Specific gravity	2.70	8.89
Relative weight	1.00	3.292
Relative weight, equal conductivity	1.00 0.483	2.0705 1.000

Ultimate strength, hard drawn, lb./in.²	24,000	60,000
Relative breaking load, equal conductivity	0.636	1.000
Skin effect ratio, equal d.c. resistance	Identical	
Thermal conductivity, watt-centigrade-centimeter	2.11	3.84
Relative thermal conductivity	0.549	1.000
Temperature coefficient of resistance (centigrade)	0.00403	0.00393
Temperature coefficient of expansion (centigrade)	0.0000231	0.0000165
Melting point, deg. C.	658.7	1,083
Boiling point, deg. C.	1,800	2,310
Specific heat at 20 deg. C.	0.212	0.0915

It is claimed that of the intrinsic advantages of "Alectral" wires and cables, the most obvious is light weight. Although the relatively great saving in bare conductor weight is partially offset by increased weight of covering, the complete Alectral insulated conductor is materially lighter. Lightness, particularly in larger cable sizes, facilitates installation. When used in vertical runs, where hung on a messenger, or in similar applications where strength of supporting structure is involved, the advantage of weight saving is an important economic factor.

Operating advantages claimed for the insulated aluminum wires and cables are that for equal direct-current resistance, i.e., conductivity, "Alectral" cables have greater current-carrying capacity and lower impedance. The importance of these two characteristics, it is stated, in considering the entire range of cable sizes can hardly be over-emphasized, and these advantages they claim are in no way minimized in the larger cable sizes, by skin effect ratios, since these ratios have been shown, through investigation, to be identical with those of equivalent copper.

The manufacturers state that it has been shown by a series of tests, simulating actual operating conditions and using conductors of large cross-section, that "Alectral" cables subjected to short circuit currents burn clear more quickly, with less attendant eruptive phenomena and less system disturbance than are commonly experienced with faulted conductors in heavy load density underground distribution networks.

Heavy-Duty Apron Feeder

A NEW DESIGN of heavy-duty manganese steel apron feeder for heavy-duty service is announced by the Link-Belt Co., Chicago, Ill.

The new feeder is said to be suitable for handling either abrasive or non-abrasive material containing lumps of ¼-in. size, and smaller, up to 6-ft. dimensions, being especially adapted to the handling of extremely heavy, large, lumpy and abrasive materials.

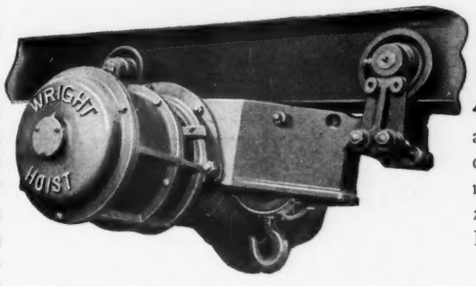
Sprockets, chains, rollers, and apron pans are of cast manganese steel

Sprockets, chains, rollers and overlapping apron pans are made of cast manganese steel, and the pans, which are ribbed, are ⅜ in. to 1½ in. thick, depending upon the service.

The broad wearing surfaces of the links of the Link-Belt rivetless manganese steel chains form tracks for the large manganese steel rollers, supporting the material carrying run. These rollers are closely spaced, and mounted on heavy through shafts turning in accessible closed-end bearings.

Electric Hoist Requires Little Headroom

THE NEW Type WH electric hoist made by Wright Manufacturing Co., Bridgeport, Conn., is designed for installations with minimum headroom. The minimum distance from the bottom of the I-beam to the hook on the ½-ton hoist is 11 in. and on the 1-ton hoist 13 in. It is claimed hoist drum and sheaves are of ample size to prevent excessive cable wear. Push button or pendant rope control is optional. A safety type limit switch, safety type load block, positive mechanical brake, oil bath lubrication, and heat-treated forged gears and pinions are used on each size.



Electric hoist has safety type limit switch and positive mechanical brake

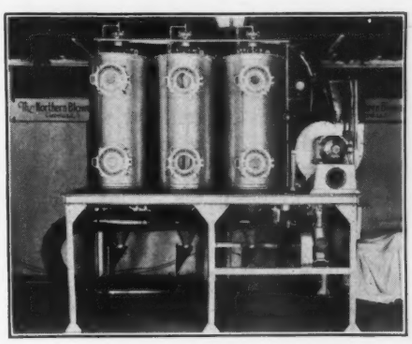
Aluminum Truck Bodies

TRUCK BODIES for many types of work are now being made of aluminum. It is claimed lower body weight that results with the use of aluminum will cut a truck's operating cost. Savings that result vary with the application. A number of such units are now serving the rock products industry, and Aluminum Co. of America, Pittsburgh, Penn., states the alloy aluminum bodies withstand this service very well.

Dust Collection System

A CONTINUOUS SUCTION air filter is being produced by Northern Blower Co., Cleveland, Ohio. It consists of three separate cylindrical units fitted with cloth filter bags, and is stated to be capable of recovering more than 99% of the finest dust.

In this type of filter the bags are kept free from dust-clogging by means of a motor-driven timing valve which cuts each unit out of the filtering line, reverses the direction of its air-flow, while shaking the fabric vigorously, and then replaces the cleaned unit back into the line. The entire operation is automatic. Thus, it is claimed, any of the units may be cut off for any desired period for repairs or inspection by merely closing that particular set of control valves.

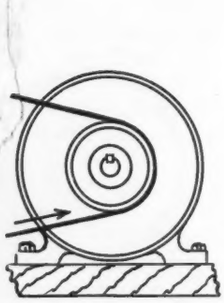


Three units in this air filter

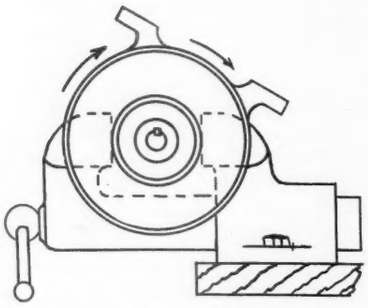
New Motor Drive

A "FLOATING" motor drive adaptable to all types of motor driven equipment, and claimed to be particularly suitable for compressors, pumps, blowers and production machinery, has been announced by the Kritzer Co., Chicago, Ill., manufacturers of the Kritzer lime hydrators.

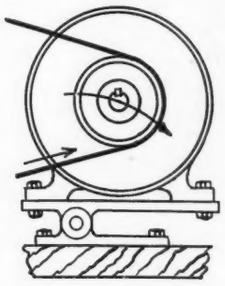
This has a patented motor mounting designed so that the driving motor "floats" on the load, maintaining just sufficient tension



Armature revolving (frame bolted)



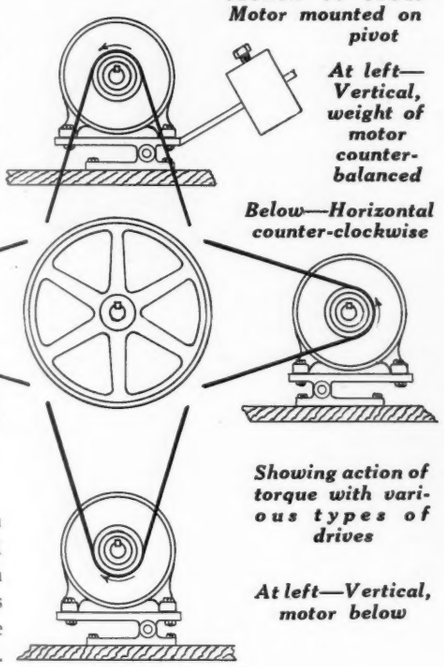
Armature locked (motor frame revolving)



Armature partially locked by belt attached to load. Motor mounted on pivot

on the belt to carry the load. According to the description, the normal increase in belt length during operation is automatically compensated without the use of idlers.

The accompanying sketches illustrate the basic principle of the floating motor drive. The manufacturers explain this principle as follows: Every action has a reaction. When a gun is fired the forward motion of the bullet is felt in the reaction of the gun itself—the "kick-back." Similarly in a motor, the rotation of the armature provides a "kick-back" to the motor frame. Were the armature itself locked as shown in the center diagram at the top of the page, the frame would revolve in the opposite direction. When the armature is "partially" locked as with a belt under load, the motor frame would revolve if it were not bolted down. With the pivot mounting shown in the drawing illustrating the armature partially locked, this reaction of the motor frame is permitted by the proper location of the pivot to increase the belt centers by moving them apart. The weight of the motor is balanced and the entire action is due to motor "torque."



At left—Vertical, weight of motor counter-balanced

Below—Horizontal counter-clockwise

Horizontal clockwise

Showing action of torque with various types of drives

At left—Vertical, motor below

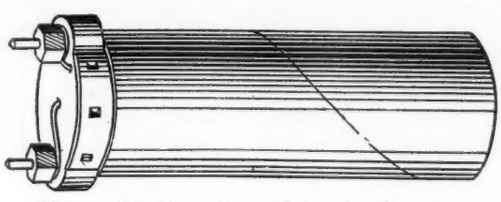
Thus the heavier the load on the belt, the greater the "kick-back" or torque reaction on the frame and the greater the tension on the belt. Conversely the lighter the load on the belt—the lighter the torque reaction on the frame and the belt tension is automatically lessened. The inertia of the driven unit in starting provides a heavy belt tension at the start of the motor, but of course this is automatically lessened as the unit gets into motion and it quickly gains its maximum efficiency.

Among the advantages claimed for the "floating" motor drive is that it permits the use of short belt centers on all applications of motor drives, it eliminates the use of idlers, gives longer belt life, eliminates belt slippage and excessive belt noise, permits use of smaller pulley sizes where necessary and eliminates motor bearing wear due to tight belts.

Safety in Using Circuit Testers for Blasting

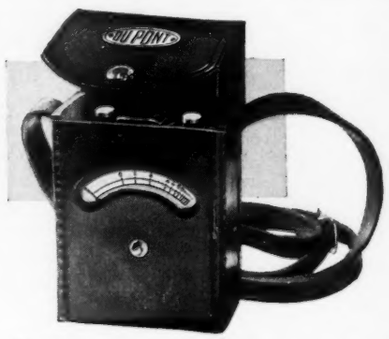
THE CIRCUIT tester developed by E. I. du Pont de Nemours and Co., Wilmington, Del., is used by shot fixers in blasting to test the approximate resistance of the wiring system before it is brought into actual use, so as to prevent misfires in blasting.

The silver chloride cell used in the circuit tester is a special element which, it is claimed, is characterized by long life and low current. In the size used, one cell without external resistance develops about 0.2 ampere and 0.9 volt. The manufacturer states that as the minimum current required for firing an electric blasting cap is about 0.4 ampere and with the voltage required to overcome the resistance of an electric blasting cap—about 1.5 volts for the shortest copper wire electric blasting cap in common use—it will be seen that there is a large margin of safety. Moreover, it is stated, in an instrument properly assembled, the internal resistance of the circuit tester is 80 ohms, which gives a further factor of safety.



Silver chloride cell used in circuit tester

Recent experiments, states the company, have proved the safety of the silver chloride cell even more convincingly. Four brand-new cells were connected in series and the terminals connected to an electric squib, which has the same firing point as an electric blasting cap. These failed to fire the squib, although the voltage was 3.6, but the volume of current was only 0.2 ampere. Next, these cells were connected in parallel, which gave about 0.8 ampere but only 0.9 volt—insufficient to overcome the resistance of the electric squib. Then they were connected in parallel series, by which a current of 0.4 ampere and 1.8 volts was produced and on momentary contact failed several times to fire the squib. When attached permanently to the terminals, however, the squib did fire—in nine minutes. Two cells connected in parallel and two others connected in series were left permanently connected to an electric squib for 16 hours without firing the squib but ruining the dry cells.



..Circuit tester in leather carrying case

Grindle Acquires Bethlehem Pulverizer

THE GRINDLE FUEL EQUIPMENT CO., Harvey, Ill., a subsidiary of the Whiting Corp., has purchased the exclusive manufacturing and selling rights to the Bethlehem pulverizer formerly manufactured by the Bethlehem Steel Co., Bethlehem, Penn.

The Whiting Corp. manufactures pulverizing equipment, power house and industrial cranes of all types, foundry equipment, railroad shop specialties, chemical equipment, and automatic stokers.

Other subsidiaries of Whiting Corp. are: Swenson Evaporator Co. and Joseph Harrington Co. These subsidiary companies of this organization are located at Harvey, Ill,

Secretary Lamont Appoints Committee to Sponsor Insulation Project

THE APPOINTMENT of a subcommittee to prepare a booklet which will acquaint builders, as well as present and prospective home owners, with the facts in regard to insulating a house, is announced by Secretary of Commerce Robert P. Lamont, who is chairman of the National Committee on Wood Utilization. The preparation of this publication is one of the special projects of the committee.

One of the primary purposes of the new booklet, a co-operative project between government and industry, is to inform the non-technical consumer of the advantages and economies of house insulation. The discomforts of excess heat in summer and cold in winter are known to everyone. The publication will reveal how these conditions may be remedied, and therefore should be of special interest to every home dweller. These factors and many others will be studied in detail by the subcommittee, and the results of their findings incorporated in the booklet.

Members of the subcommittee sponsoring this project and the organizations they represent are as follows: Le Roy E. Kern, American Institute of Architects, chairman; M. C. Betts, American Society of Agricultural Engineers; Wm. F. Chew, National Association of Builders Exchanges; W. H. Ham, Better Homes in America; E. J. Harding, Associated General Contractors of America, Inc.; C. H. Osborne, Building Officials' Conference; Wm. S. Quinter, U. S. League of Building and Loan Associations; Leonard P. Reaume, National Association of Real Estate Boards; F. B. Rowley, American Society of Heating and Ventilating Engineers; W. A. Slater, consulting engineer; James S. Taylor, Bureau of Standards; S. Percy Thompson, National Retail Lumber Dealers Association.

Since porous gypsum, porous concrete, diatomaceous earth, mineral wool, etc.—all rock products—make the best, safest and effective insulation for homes, it is to be hoped rock products producers will have sufficient foresight to see that these materials are not forgotten in the report.

New Book on Core Drilling

AN INTERESTING and informative book has recently been issued by E. J. Longyear Manufacturing Co., Minneapolis, Minn. The first section of the book is devoted to diamond drilling, sampling methods, surveying of drill holes, controlling the direction of holes, and suggestions for selection of a diamond drilling outfit.

The last section of the book illustrates and describes in detail many types of drills. Specifications of steam drills are summarized. Diamond-drill equipment and supplies are also shown. Complete data on these are given.

C. H. Adamson, Chicago Sales Manager

ANTICIPATING A RAPID industrial growth for the Chicago district, the Stephens-Adamson Manufacturing Co., Aurora, Ill., has placed C. H. Adamson, secretary of the firm, in direct charge of sales and engineering for the Chicago territory. The engineering personnel has been increased

C. H. Adamson

and the offices have been moved to new quarters in the Civic Opera Building at 20 North Wacker Drive.

Mr. Adamson is well known in the Chicago district, having been director of all Stephens-Adamson advertising and sales promotion for years. He is a graduate of Carnegie Institute of Technology and was for several years a sales engineer in the Pittsburgh, Penn., territory.

New Handbook on Concrete

USEFUL AND UP-TO-DATE information on concrete, both plain and reinforced, is contained in the new "Handbook of Concrete Construction" just issued by the Universal Atlas Cement Co., Chicago, Ill.

The book is written from a practical standpoint. It makes no attempt to cover the field of large construction projects. It is a pocket manual of general information on concrete, applying particularly to smaller structures.

Beginning with a concise discussion on concrete as a construction material, the first chapter is devoted to making good concrete. It traces step by step methods of mixing, placing and curing concrete on the average job. This includes consideration of materials, equipment and labor and a clear presentation of the water-cement ratio method. In the second chapter the basic rules of reinforcing concrete are briefly presented. There follows, in the remaining three chapters, discussion of forms for concrete, construction of small concrete structures and simple rules for estimating quantities and costs.

United States Gypsum Co. to Expand Steel Products Plant

DECISION of the United States Gypsum Co. to substantially increase production of its product in Warren, Ohio, and to let contracts for the erection of a $100,000 addition to the Phoenix road plant is reported. The specifications will call for a 50,000 sq. ft. addition and will give employment to approximately 100 more men.

Reports say that the contracts will be let within the next two or three weeks and that construction will begin immediately thereafter.

It is reliably reported that the contractors will be asked to rush the new addition to completion so that it can be placed in operation as soon as possible. It was stated that U. S. Gypsum officials decided to enlarge its Warren holdings after a complete survey of their numerous factories and that the officers hold a bright outlook for the success of the local plants.

Arrangements were recently completed whereby the company entered into a pact with the Thomas Merriweather Co., of Akron, for the exclusive manufacture and sales rights of its patented metal arch, an article which is being widely used in modern home construction.

It is also authentically reported that the U. S. Gypsum will take on the manufacture of other items to be fabricated from steel and that the Warren plant will be the center for this type of product.

Officials of the company are also reported to have pointed out that Warren is ideally located as a storage plant. They indicate that the city is perfect from a geographical standpoint and that its railway and shipping facilities well merit all consideration.—*Warren* (Ohio) *Chronicle.*

Raw Materials and Plant Locations for the Chemical and Process Industries

RAW MATERIALS, markets and transportation are the three most important factors in determining the right location of a chemical manufacturing or processing plant, says the Missouri Pacific Railway in its recent publication, "Raw Materials and Plant Locations for the Chemical and Process Industries in Missouri Pacific Lines Territory."

The principal raw materials for the chemical industry occurring in this territory are pointed out, and attention directed to locations where particular lines of chemical manufacturing would seem to have definite economic advantages. Dolomite, gypsum, limestone, oyster shells and silica are among the products briefly surveyed in this booklet. Maps show the geographical location of these deposits and photographs show a number of industrial plants in the area described.

The Rock Products Market

Wholesale Prices of Aggregates

(F.O.B. Plant or City Designated)

Prices given are for crushed limestone per ton, unless otherwise stated

	Crushed stone screenings, ¼ in. down	Crushed stone, ½ in. and less to 2½ in.	Sand, ¼ in. and less	Gravel, ½ in. and less to 2 in.	Slag screenings, ¼ in. down	Crushed slag, ½ in. and less to 3 in. and larger
EASTERN:						
Albany, N. Y.			.70	1.00		
Bethlehem, Penn.					.50– .60	.60–1.00
Birdsboro, Penn. (trap rock)	2.10	2.20–2.50				
Buffalo, N. Y.			1.00–1.10	1.00–1.10		
Devault, Penn.	.85–1.15	1.05–1.80				
Georgetown, D. C.			.85	1.30		
New York City			1.00*	1.50–1.65f		
Oriskany Falls, N. Y.	.50–1.00	1.00–1.35				
Philadelphia, Penn.			.85a	1.35–1.45a		
Pittsburgh, Penn.			1.75–2.50†	1.55–2.30†		
Prospect Junction, N. Y. (o)	.50– .80a	a.85–1.25p				
Rochester, N. Y.			1.40–1.80	1.40		
CENTRAL:						
Bloomington, Ind.			1.20	1.35		
Chicago, Ill.	1.40	1.40–1.50	1.00–1.20	1.00		
Columbus, Ohio			.50– .60j	.75j		
Eau Claire, Wis.			.40	.50– .85b		
Grand Rapids, Mich.			.40	.54– .60		
Greenbush, Mich.			.55	.75c		
Hannibal, Mo.	1.40	1.40				
Jackson, Ohio					.65‡	1.05–1.55‡
Indianapolis, Ind.			.40– .50d	.60– .70d		
Ironton, Ohio					1.05‡	1.45–1.80‡
Kansas City, Mo.			1.20			
Milwaukee, Wis.	1.14	1.24	.62	.72		
Pekin and Peoria, Ill.			.20– .60	.30– .60		
St. Louis, Mo. (e)	1.20–1.40	1.20–1.40	.80– .90	1.00–1.15		
St. Paul, Minn.		1.25	.35	1.25		
Sheboygan, Wis.	1.00	1.00				
SOUTHERN:						
Ashland, Ky.					1.05‡	1.45–1.65‡
Birmingham, Ala.‡					.55‡	q.90–1.15‡
Cayce, S. C. (granite)		1.40–1.60g				
Columbia, S. C. (granite)	.25– .40	1.25–1.60				
Dallas, Tex. (h)	1.50	2.00–2.25				
Dallas, Tex. (trap rock)	1.50	3.00–3.25				
Fort Worth, Tex.			1.50j	1.65j		
Houston, Tex.			k1.25*	1.95a		
Knoxville, Tenn.		1.30h				
Longdale, Va.					.75	.95–1.15
Montgomery, Ala.			.25– .35	.50– .60		
New Braunfels, Tex.	.60	.75–1.00				
Richmond, Va. (r)			1.50–1.65	1.90–2.10		
Rocky Point, Va. (m)	.30– .60	.75–1.10				
Tyrone, Ky.	.50– .90	.50–1.25				
Waco, Tex.			.90	1.15–1.25c		
WESTERN:						
Denver, Colo.			1.00–1.40*	1.60–2.30*		
Phoenix, Ariz.			1.65–1.75*	1.50–1.65*		
Salt Lake City, Utah			.60	.60– .80		
Seattle, Wash.			1.25*	1.25*		
Tulsa, Okla. (n)	.70	1.20–1.60				

*Prices per cu. yd. †Less 10c per ton monthly settlements disc. ‡Prices less 5c disc. per ton for payment 15th following month. (a) Consumer prices subject to cash disc. of 10c per ton. (b) ½ in. to 1½ in. (c) 1½ in. and less. (d) F.o.b. trucks at plant. (e) Asphalt filler dust in bulk 4.75, in 3-ply paper bags, 5.40. (f) Price per cu. yd. f.o.b. scows. (g) ¾ in. to 2½ in. (h) F.o.b. cars Knoxville, including tariff for 15 mile R. R. haul. (j) Price f.o.b. cars. (k) Cash disc. 2%. (m) F.o.b. plant. (n) 5% cash disc. payment 10 days; 30 days net. (o) F.o.b. cars or truck at plant. (p) ⅜ in. to ¾ in., 1.10. (q) ¾ in. and less to 2½ in. (r) Prices, L.C.L. delivered in city.

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point.

Chester, Vt.—Finely ground talc (carloads), Grade A—99-99¾% thru 200 mesh, 8.00–8.50; Grade B, 97-98% thru 200 mesh 7.00– 7.50
1.00 per ton extra for 50-lb. paper bags; 166⅔-lb. burlap bags, 15c each; 200-lb. burlap bags, 18c each. Credit for return of burlap bags. Terms 1%, 10 days.

Clifton, Va.:
Ground talc (150-200 mesh), in bags 10.00

Emeryville, N. Y.:
Ground talc (200 mesh), bags 13.75
Ground talc (325 mesh), in bags 14.75

Hailesboro, N. Y.:
Ground talc (300-350 mesh), in 200-lb. bags 15.50–20.00

Henry, Va.:
Crude (mine run), bulk 3.50– 4.00
Ground talc (150-200 mesh), in bags .. 6.25–11.00

Los Angeles, Calif.:
Ground talc (150-200 mesh), in bags .. 15.00–25.00

Natural Bridge, N. Y.:
Ground talc (325 mesh), bags 10.00–15.00

Pulverized Limestone for Coal Operators

Davenport, Ia.—Analysis, 92-98% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 20 mesh, 50% thru 200 mesh; sacks, ton .. 6.00
Piqua, Ohio—99% thru 100 mesh, bulk, 3.25; in 80-lb. or 100-lb. bags 4.25
Rocky Point, Va.—Analysis, 97% $CaCO_3$; 75% $MgCO_3$; 85% thru 200 mesh, bulk 2.25–3.50
Waukesha, Wis.—90% thru 100 mesh, bulk 4.50

Roofing Slag

Prices given are per ton f.o.b. city named, unless otherwise noted.

Ashland, Ky.	2.05*
Bethlehem, Penn.	1.00–1.50‡
Birmingham, Ala.	2.05*
Buffalo, N. Y.	2.50†
Ironton, Ohio	2.05*
Jackson, Ohio	2.05*
Longdale, Va.	2.50

*Less 5c ton disc. for pay. 15th following month. †Price f.o.b. trucks at plant, subject to discount of 10c per ton for payment on or before the 15th of following month. ‡F.o.b. plant.

Agricultural Limestone

(Crushed)

Cartersville, Ga.—50% thru 50 mesh	1.50
Chico, Tex.—Limestone flour, or mill floats, per 100-lb. bag, f.o.b. plant	1.00
Colton, Calif.—Analysis, 95-97% $CaCO_3$; 1.31% $MgCO_3$, all thru 14 mesh down to powder	3.50
Cypress, Ill.—90% thru 100 mesh, 1.25; 50% thru 100 mesh, 1.25; 90% thru 50 mesh, 1.25; 50% thru 90 mesh, 1.25; 90% thru 4 mesh, 1.25; and 50% thru 4 mesh	1.25
Davenport, Iowa — Analysis, 92-98% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 4 mesh, 50% thru 20 mesh; bulk	1.10
Dolomite, Calif.—Analysis, 54% $CaCO_3$; 45% $MgCO_3$; 99% thru 10 mesh, per ton, 2.10; 49% thru 60 mesh, ¼-in. to dust, per ton	1.70
Dubuque, Ia.—Analysis, 64.04% $CaCO_3$; 30.54% $MgCO_3$; 90% thru 50 mesh	1.05
Fort Spring, W. Va.—Analysis, 92% $CaCO_3$; 3% $MgCO_3$; 50% thru 50 mesh; bulk, per ton	1.15
Gibsonburg, Ohio—Analysis, 55% $CaCO_3$; 43.40% $MgCO_3$; 50% thru 50 mesh	1.25
Lannon, Wis. — Analysis, 54% $CaCO_3$; 44% $MgCO_3$; 99% thru 10 mesh; 46% thru 60 mesh	2.00
Screenings (¼-in. to dust)	1.00
Marblehead, Ohio—90% thru 100 mesh	3.00
90% thru 50 mesh	2.00
90% thru 4 mesh	1.00
Marlbrook, Va.—Precipitated lime-marl. Analysis, 97% $CaCO_3$; 1% $MgCO_3$; 90% thru 50 mesh, bulk, 2.25; in burlap bags	3.75
Olive Hill, Ky.—90% thru 4 mesh	.50–1.00
Branchton, Penn.—100% thru 20 mesh, 60% thru 100 mesh, and 45% thru 200 mesh, per ton	a4.00
Piqua, Ohio—30%, 50% and 99% thru 100 mesh	1.00–4.00
Stolle and Falling Springs, Ill.—Analysis, 89.9% $CaCO_3$; 3.8% $MgCO_3$; 90% thru 4 mesh	1.15–1.70
Stone City, Ia.—Analysis, 98% $CaCO_3$; 50% thru 50 mesh	.75
West Stockbridge, Mass.* — Analysis, 95% $CaCO_3$; 90% thru 50-mesh, bulk	3.50
100-lb. paper bags, 4.75; 100-lb., cloth	5.25
Waukesha, Wis.—90% thru 100 mesh, 3.50–4.90; 50% thru 100 mesh	2.10

*Less 25c disc. 15 days. (a) Less 50c commission.

Agricultural Limestone

(Pulverized)

Alton, Ill.—90% thru 100 mesh	4.00
Bedford, Ind.—90% thru 10 mesh	1.50
Bellefonte, Penn.—100% thru 30 mesh, 80% thru 100 mesh, 60% thru 200 mesh, in bulk per ton, 3.00*; in 80-lb. paper bags, per ton, 3.75*; 20-mesh pulverized limestone, 100% thru 20 mesh, 65% thru 100 mesh, 45% thru 200 mesh, in bulk per ton, 2.50*; in 80-lb. paper bags	*3.25
Cape Girardeau, Mo.—Analysis, $CaCO_3$, 94½%; $MgCO_3$, 3½%; 90% thru 50 mesh	1.50
Cartersville, Ga.	1.75
Davenport, Iowa — Analysis, 92-98% $CaCO_3$; 2% and less MgCO†; 100% thru 20 mesh, 50% thru 200 mesh; sacks, per ton	6.00
Gibsonburg, Ohio—Analysis, 55% $CaCO_3$; 43.40% $MgCO_3$; bulk, 3.00; in bags	4.50
Hillsville, Penn.—Analysis, 94% $CaCO_3$, 1.40% $MgCO_3$, 75% thru 100 mesh; in bags	5.00
Jamesville, N. Y.—Bulk, 4.10; in 80-lb. bags	5.35
Joliet, Ill.	3.50
Knoxville, Tenn.—Analysis, 52% $CaCO_3$; 36% $MgCO_3$; 80% thru 100 mesh; in 100-lb. paper bags, 3.75; bulk	2.50
Marion, Va.—Analysis, 90% $CaCO_3$; 2% $MgCO_3$; per ton	2.00
Middlebury, Vt.—Analysis, 99.05% $CaCO_3$; 90% thru 50 mesh	4.25
West Rutland, Vt. — Analysis, 96.5% $CaCO_3$; 1% $MgCO_3$; 90% thru 50 mesh; bags, per ton, 3.75; bulk	2.50

*Less 25c discount 10 days.

Portland Cement

	F.o.b. city named Per Bag	Per Bbl.	High Early Strength
Atlanta, Ga.	.....	†2.00	3.05¶
Birmingham, Ala.	.....	†1.66	2.71¶
Boston, Mass.	.43½	†1.74	2.63¶
Charleston, S. C.	.....	1.89†	3.01¶
Jackson, Miss.	.....	2.10†	3.10¶
Jacksonville, Fla.	.....	2.12†	3.17¶
Memphis, Tenn.	.....	†1.91	2.96¶
New Orleans, La.	.....	1.86†	2.96¶
New York, N. Y.	.41	†1.64	2.39¶
Norfolk, Va.	.....	1.68	2.58¶
Portland, Ore.	.60	2.50‡	.....
Reno, Nev.	.....	2.96‡	.....
Richmond, Va.	.....	2.01	2.66¶
San Francisco, Calif.	.....	2.24‡	.....
Savannah, Ga.	.....	1.89†	2.94¶
Seattle, Wash.	.....	1.50–1.55	2.50c
Tampa, Fla.	.....	2.00†	3.16¶
Winston-Salem, N.C.	.....	2.04	2.94¶
Mill prices f.o.b. in carload lots, without bags, to contractors.			
Hudson, N. Y. (d)	.....	1.36–1.51†	e2.44¶
Lime & Oswego, Ore.	.....	2.50	.....

NOTE: Unless otherwise noted, prices quoted are net prices, without charge for bags. Add 40c per bbl. for bags. *Includes dealer and cash discounts. †Includes 10c cash discount. ‡Subject to 2% discount payment 10th of month following invoice date. ¶"Incor" Perfected, prices per bbl. packed in paper sacks, subject to 10c discount 15 days. (c) Quick-hardening "Velo," packed in paper bags, 10c discount 10 days. (d) 1.36 cars mill; 1.51 truck mill. (e) F.o.b. truck mill.

Glass Sand

(Silica sand is quoted washed, dried and screened)

Cheshire, Mass. (in carload lots)	5.00
Klondike, Mo.	2.00
Ohlton, Ohio	2.40
South Vineland, N. J.	1.75
San Francisco, Calif.	4.00–5.00
Silica, Va.	2.50–3.00

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Eau Claire, Wis.	4.30	1.00
Ohlton, Ohio	1.60	1.60
San Francisco, Calif.	3.50	3.50

Masonry Cement

The prices shown here are for various brands of masonry and mortar cement, including cost of bags.

	Per bag	Per bbl.
Atlanta, Ga.	.42¼	1.69–2.24*
Baltimore, Md.	.40¾	1.63–2.21*
Birmingham, Ala.	.42¼	1.69–2.21*
Boston, Mass.	.....	2.25*
Buffalo, N. Y.	.....	2.10*
Charleston, S. C.	.42¼	1.69–2.39*
Chicago, Ill.	†.46	†1.84–2.09*
Cincinnati, Ohio	†.43½	†1.74–1.99*
Cleveland, Ohio	†.46¾	†1.87–2.12*
Columbus, Ohio	.43¼	1.73–2.07*
Dallas, Tex.	.....	2.69*
Dayton, Ohio	†.44	†1.76–2.02*
Des Moines, Ia.	.....	2.34*
Detroit, Mich.	†.46¾	†1.87–2.12*
Indianapolis, Ind.	†.42½	†1.70–1.95*
Jackson, Miss.	.....	2.31*
Jersey City, N. J.	.42¼	1.69–2.20*
Kansas City, Mo.	.....	2.39*
Louisville, Ky.	†.40½	†1.62–1.97*
Memphis, Tenn.	†.48½	†1.94–2.20*
Milwaukee, Wis.	.....	2.12*
New Orleans, La.	.....	2.43*
New York, N. Y.	.42¼	1.69–2.20*
Norfolk, Va.	.41¾	1.67–2.31*
Philadelphia, Penn.	.41¼	1.65–2.21*
Pittsburgh, Penn.	.42¼	1.69–2.10*
Richmond, Va.	.41¼	1.65–2.37*
St. Louis, Mo.	†.45¾	†1.83–2.10*
Toledo, Ohio	†.46	†1.84–2.09*
Tulsa, Okla.	.....	2.61*
Wheeling, W. Va.	.42¼	1.69–2.09*
Winston-Salem, N. C.	.....	2.31*
Mill price in carload lots, to contractors:		
Riverton, Va.	.....	1.38

*Price for delivery in car lots to contractors at point given, including value of cloth sacks, for which refund is made of 10c each when returned in good order. Shipped in paper bags 25c a bbl. less. Price subject to cash discount of 10c bbl. for payment 15 days from date of invoice.

†Packed in paper sacks; price includes cost of sacks.

Mica

Prices given are net, f.o.b. plant or nearest shipping point.

Rumney Depot, Bristol and Cardigan, N. H.—Per ton:	
Punch mica, per ton	150.00–240.00
Mine scrap	22.50
Mine run	325.00
Clean shop, scrap	25.00
Roofing mica	37.50
Ground mica, per ton, 20 mesh, 37.50; 40 mesh, 40.00; 60 mesh, 40.00; 100 mesh. 45.00; 200 mesh	60.00
Spruce Pine, N. C.—Mine scrap, per ton	18.00– 20.00

Chicken Grits

Bellefonte, Penn.—(Limestone) Coarse, mixed, in 100-lb. jute bags, per ton, 8.00; in bulk, per ton	4.50
Cypress, Ill.—(Agstone), per 100-lb. sack	.90
Chico, Tex.—Hen size and Baby Chick, packed in 100-lb. sacks, per 100-lb. sack, f.o.b. Chico	1.00
Cranberry Creek, N. Y.—Packed in 100-lb. bags	¶9.00–12.00‖
Davenport, Iowa—High calcium carbonate limestone, in bags, L.C.L., per ton	6.00
El Paso, Tex.—(Limestone), per 100-lb. sack	.75
Gibsonburg, Ohio—(Agstone)	10.00
Joliet, Ill.—(Agstone)	10.00
Los Angeles. Calif.—(Gypsum), per ton, including sacks	7.50– 9.50
Marble grits, per ton, incl. sacks	10.00–12.50
Middlebury, Vt.—Per ton (a)	10.00
Piqua, Ohio—(Pearl grit), No. 1 and No. 2	1.00– 4.00
Port Clinton, Ohio—(Gypsum), per ton	6.00
Randville, Mich.—(Marble), per ton, bulk	6.00
Warren, N. H.	8.50– 9.50
Waukesha, Wis.—(Limestone), per ton	7.00
West Stockbridge, Mass.	¶7.50–‖9.00

(a) F.o.b. Middlebury, Vt. ¶C.L. ‖L.C.L.

Rock Phosphate

Prices given are per ton (2240 lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

Gordonsburg, Tenn.	4.25– 4.75
Mt. Pleasant, Tenn.: (Screened)	
B.P.L. 75%, furnace lump	6.50
B.P.L. 72%, run of plant lump & fines	5.50

Ground Rock
(2000 lb.)

Gordonsburg, Tenn.	5.25– 6.00
Mt. Pleasant. Tenn.—(Lime phosphate) —B.P.L. 75%; per ton, bags extra	12.80
Mt. Pleasant, Tenn.—B.P.L. 72%	5.50

Florida Phosphate

(Raw Land Pebble)

Mulberry, Fla.—Gross ton, f.o.b. mines	
68/66% B.P.L.	3.15
70% minimum B.P.L.	3.75
72% minimum B.P.L.	4.25
75/74% B.P.L.	5.25
77/76% B.P.L.	6.25

Core and Foundry Sands

Silica sand quoted washed, dried, screened unless otherwise stated; lowest net prices per ton f.o.b. plant

City or shipping point	Molding: Fine	Molding: Coarse	Molding: Brass	Core	Furnace lining	Sand blast	Stone sawing
Albany, N. Y.	2.00	2.00	2.25	.....	.....	3.50	.....
Cheshire, Mass.	.....	.....	.....	.....	.....	5.00	.....
Columbus, Ohio	1.50	1.50	.....	.....	.....	3.50	.....
Eau Claire, Wis.	.....	.....	.....	.....	.....	2.50d	.....
Elco, Ill.	Amor. silica, 90-99½% thru 325 mesh, $10.00						
Kasota, Minn.	.....	.....	.....	.....	.....	.....	1.00
Montoursville, Penn.	.....	.....	.....	1.25c	.....	.....	.....
New Lexington, Ohio	2.00	1.75	.....	.....	.....	.....	.....
Ohlton, Ohio	1.60	1.60	.....	1.75	1.60	1.75	.....
Ottawa, Ill.	.....	.....	.....	.....	.....	3.50b	.....
San Francisco, Calif.	3.50†	5.00†	3.50†	2.50†	5.00†	3.50†	.....
Silica, Va.	Potters' flint, 8.00–10.00 per ton						
South Vineland, N. J.	Washed silica, 1.50 per ton; dry white, 2.00 per ton						

†Fresh water washed, steam dried. *Damp. (a) Filter sand, 3.00. (b) Per ton in bulk; 7.50 per ton in bags. (c) To 1.50. (d) To 3.00.

Wholesale Prices of Slate

Lowest prices f.o.b. at producing point or nearest shipping point

Slate Flour

Pen Argyl, Penn.—Screened, 300-mesh, 6.50 per ton in paper bags

Roofing Slate

Prices per square—Standard thickness

City or shipping point	3/16-in.	¼-in.	⅜-in.	½-in.	¾-in.	1-in.
Bangor, Penn.—						
Gen. Bangor No. 1 clear	10.00	20.00	25.00	29.00	40.00	50.00
Gen. Bangor No. 1 ribbon	9.00	16.00	20.00	25.00	35.00	46.00
No. 1 Albion	7.25	16.00	23.00	27.00	37.00	46.00
Gen. Bangor No. 2 ribbon	6.75	.....	.....	.....	.....	.....
Chapman Quarries, Penn.—						
Hardvein slate	8.00	13.50	20.00	25.00	30.00	35.00
Pen Argyl, Penn.—						
Graduated slate	.....	16.00	23.00	27.00	37.00	46.00

Albion blue-grey roofing slate, No. 1 clear 7.25; mediums 8.00; No. 1 ribbon 8.00.

(a) Prices are for standard preferred sizes (standard 3/16-in. slates), smaller sizes sell for lower prices.

(b) Prices other than 3/16-in. thickness include nail holes.

(c) Prices for punching nail holes, in standard thickness slates, vary from 50c to $1.25 per square.

Lime Products

(Lowest carload prices per ton f.o.b. shipping point unless otherwise noted)

	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Bulk	Ground burnt lime, Bags	Lump lime In bulk	Lump lime In bbl.
EASTERN:								
Buffalo, N. Y.	.....	.....	.....	11.00	.....	.....	.....	.....
Berkeley, R. I.	.....	.....	10.50	.....	.....	17.50	.....	19.25
Cedar Hollow, Devault, Mill Lane, Knickerbocker, Rambo and Swedeland, Penn.	.....	9.00c	9.00c	9.00c	7.50	9.00	8.50	.....
Frederick, Md.	.....	8.50	8.50	8.50	.....	8.50	6.50	13.50
Lime Ridge, Penn.	.....	.....	8.00	.....	6.00	7.00	4.50	.....
W. Stockbridge, Mass.	.....	8.25	8.25	.....	.....	13.50	10.00	15.35
CENTRAL:								
Afton, Mich.	.....	.....	.....	.....	.....	10.85	6.50	.....
Cold Springs, Ohio	.....	6.00	6.00	.....	.....	.....	6.00	.....
Martin, Gibsonburg, Marblehead, Tiffin, Ohio, and Huntington, Ind.	7.75	6.00	6.00	11.00	6.00	8.00	6.00	.....
Delaware, Ohio	7.75	6.00	6.00	7.00	6.00	.....	6.00	.....
Luckey, Ohio	7.75	6.00	6.00	.....	.....	.....	.....	.....
Milltown, Ind.	.....	9.00	8.25	9.50	7.50	.....	7.00	.....
Sheboygan, Wis.	.....	10.50	10.50	.....	.....	.....	9.50	20.00e
White Rock Ohio	7.75	.....	6.00	.....	6.00	8.00	6.00	.....
Woodville, Ohio	7.75	6.00	6.00	9.00	6.00	8.00	6.00	15.00d
SOUTHERN:								
Keystone, Ala	.....	8.00	.....	7.50	.....	.....	6.50	13.75
Knoxville, Tenn.	15.00	8.00	8.00	7.50	6.50	.....	6.50	12.50
Pine Hill, Ky.	.....	8.00	8.00	7.50	.....	.....	6.00	12.50
Richmond, Va.	11.40	10.16	10.16	10.16	8.66	10.16	8.66	.....
WESTERN:								
Little Rock, Ark.	.....	14.30	.....	14.30	.....	.....	.....	17.40
Kirtland, N. M.	.....	.....	.....	.....	.....	.....	15.00	.....
San Francisco, Cal. (b)	20.00	20.00	12.00	20.00	.....	.....	.....	.....
San Francisco, Calif.	19.00	14.00	12.50	14.00	13.00	.....	11.00	.....

(a) In 100-lb. bags. (b) Woodburnt lime: finishing hydrate, 20.00 per ton; pulv. lime, 2.00 per iron drum. Oil-burnt pulv. lime, 13.00–14.50 per ton. (c) In 50-lb. paper. (d) In steel; in wood, 14.00. (e) In steel.

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Brandon, Vt.—English pink, cream and coral pink	¶12.50–‖14.50	¶12.50–‖14.50
Cranberry Creek, N.Y.—Bio-Spar, per ton in bags, in carload lots, 9.00; less than carload lots, per ton in bags		12.00
Crown Point, N. Y.—Mica Spar		¶9.00f–‖12.00
Davenport, Ia. — White limestone, in bags, ton	‖6.00	‖6.00
Los Angeles, Calif.—(e)		
White	¶12.00–‖14.50	¶12.00–‖14.50
Snowflake		¶12.00–‖14.50
Golden, browns, grey, blues, blacks	¶16.00–‖18.50	¶16.00 ‖18.50
Dolomite, Calif. (Lone Pine)—(e)		
White	¶9.80– ‖9.80	¶9.80– ‖9.80
Snowflake		¶9.80– ‖9.80
Golden, browns, grey, blues, blacks	¶13.80–‖13.80	¶13.80–‖13.80
Middlebrook, Mo.—Red		20.00– 25.00
Middlebury, Vt.—White		¶9.00–‖10.00
Middlebury & Brandon, Vt. — Caststone, per ton, including bags		c5.50
Randville, Mich.—Crystalite, crushed white marble, bulk	4.50	4.50– 5.00
Tuckahoe, N. Y.	6.00	
Warren, N. H.		¶7.00– 11.25

¶C.L. ‖L.C.L. *Per 100-lb. (c) Per ton f.o.b. quarry in carloads; 7.00 per ton L.C.L. (e) Including bags. (f) In bags.

Art and Cast Stone Aggregates

Los Angeles, Calif.—Dolomite aggregates, all sizes and colors† ¶10.00 ‖12.50
Dolomite special cast stone, wet cast aggregate, white, ¼-in. to dust a4.70
† 100-lb. sacks. ¶C.L. ‖L.C.L. (a) In open cars.

Cement Roofing Tile

Prices are net per square, carload lots, f.o.b. nearest shipping point, unless otherwise stated.

Cicero, Ill.—French and Spanish tile, 9x15-in., per sq. 9.50–12.00
Closed end shingle, 8½x12½ in., per sq. 11.00–13.00
New Castle, Penn.—Red, 9x15-in. 12.00
Green, 9x15-in. 15.00
New York City, N. Y.:
Red, per square 10.00–12.00
Green, per square 12.00–15.00

Potash Feldspar

East Liverpool, Ohio — Color, white; analysis, K_2O, 11%; Na_2O, 2.25%; SiO_2, 67.25%; Fe_2O_3, 0.05%; Al_2O_3, 18.25%, pulverized, 99% thru 200 mesh; in bags, 20.70; in bulk 19.50

Erwin, Tenn. — White; analysis, K_2O, 10.50%; Na_2O, 2.50%; SiO_2, 67.50%; Fe_2O_3, 0.06%; Al_2O_3, 18%; pulverized, 98% thru 200 mesh; in bags, 16.50; bulk 15.00

Spruce Pine, N. C.—(Chemically controlled.) Color, white; 200 mesh; analysis, K_2O, 11.30%; Na_2O, 2%; SiO_2, 67%; Fe_2O_3, 0.10%; Al_2O_3, 18.60%; per ton, in bulk 15.00

Trenton, N. J.—Color, white; analysis, K_2O, 12%; Na_2O, 3%; SiO_2, 69%; Fe_2O_3, 0.06%; Al_2O_3, 18%; pulverized, 98% thru 200 mesh; bulk, 20.00; in bags 21.20

West Paris, Me.—(Chemically controlled.) Color, white; 200 mesh; analysis, K_2O, 11.20%; Na_2O, 3.20%; SiO_2, 65.70%; Fe_2O_3, 0.09%; Al_2O_3, 19.20%; per ton, in bulk 19.00

Rochester, N. Y.—Color, white; analysis, K_2O, 12.50%; Na_2O, 2.25%; SiO_2, 65%; Fe_2O_3, 0.04%; Al_2O_3, 19.10% pulverized 98% thru 200 mesh; in bags, 23.50; bulk 22.00

Soda Feldspar

De Kalb Jct., N. Y.—Color, white; pulverized (bags extra, burlap 2.00 per ton, paper 1.20 per ton); 99% thru 140 mesh, 16.00; 99% thru 200 mesh 18.00

Spruce Pine, N. C.—(Chemically controlled.) Color, white; 200 mesh; analysis, K_2O, 5.50%; Na_2O, 5.50%; SiO_2, 68.80%; Fe_2O_3, 0.10%; Al_2O_3, 18.60%; per ton, in bulk 18.00

Cement Building Tile

Lexington, Ky.:
5x8x12, per 1000 55.00
4x5x12, per 1000 35.00

Longview, Wash. (Stone Tile):
4x6x12, per 1000 60.00
4x8x12, per 1000 70.00

Prairie du Chien, Wis.:
5x8x12, per 1000 78.00
5x4x12, per 1000 46.00
5x8x6, per 1000 41.00

Wichita, Kan.: (Duntile)	Plain	Glazed
8x8x12. Each	.10½	.14
6x8x12. Each	.09½	.13
4x5x12. Each	.05	.08
4x4x12. Each	.04½	.07½

Fullers Earth

Prices per ton in carloads, f.o.b. Florida shipping points. Bags extra and returnable for full credit.

16– 30 mesh 20.00
30– 60 mesh 22.00
60–100 mesh 18.00
100 mesh and finer 9.00
Joliet, Ill.—All passing 100 mesh, f.o.b. Joliet, incl. cost of bags 24.00

Concrete Brick

Prices given per 1000 brick, f.o.b. plant.

	Common	Face
Beloit, Wis.	18.00	26.00– 35.00
Ensley, Ala., "Slagtex"	12.50	
Longview, Wash.	16.50	22.50– 45.00
Milwaukee, Wis.	14.00	20.00– 35.00
Omaha, Neb.	15.00	
Prairie du Chien, Wis.	14.00	22.00– 25.00
Rapid City, S. D.	16.00	30.00

*Price f.o.b. plant. †Delivered on job in city.

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point.

Beloit, Wis.:
4x8x16. Each .11
6x8x16. Each .13
8x8x16. Each .15
10x8x16. Each .19
12x8x16. Each .21
Brookville, Penn.: 8x8x16 20.00§–23.00a
8x10x16 25.00§–28.00a
Camden, N. J.: 8x8x16, each .18b
Columbus, Ohio: 8x8x16 §10.00–a11.00*
Lexington, Ky.:
8x8x16 ‡18.00*
8x8x16 †16.00*
Omaha, Neb.: (c)
8x 4x16, each .06½§
8x 8x16, each, .10§; 8x12x16, each .15§
Passaic, N. J.: 8x8x16 in. Each .16
12x8x16 in. Each .24
Wichita, Kan.: 8x8x16. Each .11§

*Price per 100 at plant.
†Rock or panel face.
‡Face. §Plain. (a) Rock face. (b) Less 10%. (c) Faced block, priced 2c higher than plain block prices quoted.

Cement Drain Tile

Grand Rapids, Mich.—Drain tile, per 1000 ft.

4-in.	40.00	15-in.	325.00
5-in.	50.00	18-in.	450.00
6-in.	75.00	20-in.	600.00
8-in.	110.00	22-in.	750.00
10-in.	165.00	24-in.	850.00
12-in.	190.00		

Longview, Wash.—Drain tile, per foot

3-in.	.06	8-in.	.18
4-in.	.08	10-in.	.25
6-in.	.12	12-in.	.35

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise noted

Culvert and Sewer	4-in.	6-in.	8-in.	10-in.	12-in.	15-in.	18-in.	20-in.	22-in.	24-in.	27-in.	30-in.	36-in.	42-in.	48-in.	54-in.	60-in.
Grand Rapids, Mich. (a)																	
Sewer	.....	.12	.18–.20	.27½	.35	.57½	1.00	1.11	1.48	1.66	.....	.....	.....	.....	.....	.....	.....
Culvert	.....	.....	.....	.57	.67	.93	1.20	.....	1.48	1.80	2.10	2.25	3.35	4.00	5.10	5.85	7.42
Longview, Wash.	.17½	.24½	.30	.42	.60	.90	1.26	.....	.....	2.16	.....	3.60	4.50	5.50	6.50	7.50	.....
Mercedes, Texas																	
Tongue and groove	.16	.20	.23	.29	.35	.....	.74	.91	.....	1.38	.....	2.28	.....	.....	.....	.....	.....
Sewer	.16	.22	.32	.41	.53	.78	1.05	.....	.....	1.98	.....	.....	.....	.....	.....	.....	.....
Milwaukee, Wis.						Cast stone window sills, 5 in. x 5½ in., 50c per lineal ft.											
Tiskilwa, Ill. (c)	.....	.....	.....	.75	.85	.95	1.20	1.60	.....	2.00	.....	2.75	3.40	.....	6.50	.....	10.00
Wahoo, Neb. (b)	.....	.....	.....	.85½	.....	.....	1.14	.....	.....	1.81	.....	2.47	3.42	4.13	5.63	6.49	7.31

†21-in. diam. (a) Sewer pipe, 21-in., 1.29; culvert, 21-in., 1.45. (b) Reinforced, 15.40 per ton, f.o.b. plant. (c) Reinforced.

Gypsum Products—CARLOAD PRICES PER TON AND PER M SQUARE FEET, F.O.B. MILL

City or shipping point	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco Calcined Gypsum	Cement and Gaging Plaster	Wood Fiber	Gaging White	Plaster Sanded	Cement Keene's	Finish Trowel	Plaster Board ¼x32x 36". Per M Sq. Ft.	Plaster Board ⅜x32x 36". Per M Sq. Ft.	Wallboard, ⅜x32 or 48" Lengths 6'-10'. Per M Sq. Ft.
East St. Louis, Ill.—Special Gypsum Products—Partition section, 4 in. thick, 12 in. wide, and up to 10 ft. 3 in. long, 12c per ft., 21.00 per ton; outside wall section and interior bearing wall section, 6 in. wide, 6 in. thick, and up to 10 ft. 3 in. long, 25c per ft., 30.00 per ton; floor section, 7 in. thick, 16 in. wide, and up to 13 ft. 6 in. long, 17c per ft., 23.00 per ton.													
Grand Rapids, Mich.	.....	.....	6.00b	10.00b	10.00b	10.00b	19.50b	8.00b	26.00b	21.00b	15.00	15.00	27.00
Los Angeles, Calif. (a)	.....	.....	7.50	.....	12.20b	.....	13.20b	.....	.....	13.20b	.....	.....	.....
Medicine Lodge, Kan.	1.45	8.00b	.....	.....	.....	.....	11.50b	.....	16.00b	.....	.....	.....	.....
Oakfield, N. Y.	.....	.....	.....	6.00	9.00b	9.00b	.....	6.00b	.....	.....	.....	.....	.....
Port Clinton, Ohio	4.00	6.00–8.00	6.00–8.00	10.00p	10.00q	10.00q	20.00k	8.00–11.00	24.50f	26.00g	15.00h	15.00h	27.00j
Rumford, R. I. (n)	.....	.....	.....	14.00m	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco, Calif.	.....	.....	.....	.....	14.90b	.....	.....	.....	.....	.....	.....	.....	.....
Winnipeg, Man.	5.00	5.00	7.00	13.00	14.00	14.00	.....	.....	.....	.....	20.00	25.00c	33.00d

NOTE—Returnable bags, 10c each; paper bags, 1.00 per ton extra (not returnable). (a) Plaster board, ⅜x16x48-in., weight 1850 lb., 16c a yd. (b) Includes paper bags. (c) Includes jute sacks. (d) "Gyproc," ⅜x48-in. by 5 and 10 ft. long. (e) ⅜x48-in. by 3 to 4 ft. long. (f) To 27.50. (g) To 29.00. (h) To 16.00. (j) To 28.00. (k) To 23.00. (m) In jute sacks, delivered in Providence, R. I. (n) Gypsum block, 2-in., 6c per foot; 3-in., 7c per foot. (p) To 12.00. (q) To 13.00.

Prices Bid and Contracts Awarded

St. Paul, Minn.—The state highway department is executing new contracts to replace contracts made last December for 999,982 bbl. of cement required for the 247 miles of paving then on the program, and is also executing contracts at the present low market price for the cement needed for the additional pavement made possible by the bond issue bill and the special federal aid. The contracts are on the basis of 90c per bbl. net in bulk in cars at the mills, plus freight to the station nearest the paving project.

The December contracts contained a provision that if market prices went lower than those named in the contracts, the manufacturers were to be paid at the prevailing market price on the date of shipment. If cement prices go above the present price during the spring or summer, the state would have to pay the market price, as long as as it did not exceed the price fixed by the old contracts, but by writing new contracts, it will get all the required cement at the low price now prevailing, and also get the benefit of any further drop, if there should be any.

Delivered prices vary in different parts of the state, but on some of the projects the new low price will cut the cost of cement more than 25%.—*Albert Lea* (Minn.) *Tribune.*

* * * * *

Detroit, Mich.—The wrangle over the purchase of crushed stone for the city's season's requirements, which has continued periodically for several months before the council was settled recently when the council unanimously approved the recommendation of Douglas Dow, commissioner of purchases and supplies, and awarded the contract for "binder stone" to the Lake Ports Supply Co.

This action was taken following a readvertisement of bids on recommendation of Mr. Dow, with the result that the city saved approximately $12,840 on the prices previously offered.

As in other stone contracts, the bids were highly complicated and several companies claimed to be low. As the chief contesting bidder, the France Stone Co. received the other large crushed stone contract, 125,000 tons for surface work, about a month ago. Mr. Dow recommended that Lake Ports be awarded this contract, since it is a Detroit taxpayer and employes Detroit labor.

The contract is for 70,000 tons, more or less, and Lake Ports bid was $1.34 per ton. Lake Ports bid on the previous advertising was $1.55.—*Detroit* (Mich.) *News.*

* * * * *

Fort Dodge, Ia.—Herman Miller of Hartley, Ia., was awarded a contract for graveling 120 miles of Webster county's secondary road system at a letting held by the board of supervisors.

His bid of $50,000 was the lowest of eight submitted. The new lowest, submitted by Munson and Maudlin of Boone and Nevada, was $1900 higher than Miller's.

County officials describe Mr. Miller's bid as the lowest and the contract as the biggest in the memory of the county.

Mr. Miller will be paid 14c per cu. yd. of gravel for screening, loading and hauling the first mile, 3.6c per cu. yd. for each additional mile of haul and 8c per cu. yd. for stripping. The contract calls for spreading 97,300 cu. yd. of gravel.

* * * * *

Montreal, Que.—Included in the reports adopted by the Montreal city council is one authorizing the purchase of 200,000 bbl., needed for pavements and sidewalks which the city will lay this summer. The contract amounts to $468,000, and will be equally divided between the Canada Cement Co., Ltd., and the National Cement Co., Ltd., at the price of $2.34 per bbl., gross. Sales tax included, discount of 10c per bbl. for payments in 20 days from date of shipment, or on the 10th of the month following the shipment or in 30 days net. It is further stated that a credit of 20c per sack will be granted for each cotton sack returned, and that any increase in the government sales tax will be charged to the city of Montreal.

* * * * *

Concord, N. H.—The prices for materials as submitted to the state highway department are as follows:

	Gravel	Sand
Vogel and Hadley, Manchester and West Lebanon	$0.90	$0.35
A. L. Garmon, East Weare	1.00	0.35
Winslow and Cummings, Milford	1.00	0.25

* * * * *

Knoxville, Tenn.—The proposal of W. T. Ellis, present contract holder, to supply the city with crushed rock from the city quarry on Central avenue pike for $1.43 per cu. yd. was apparently low when two proposals were opened recently.

Lambert and Henry bid $1.46 on the city quarry.

The alternative bid for use of any quarry was: Ellis, $1.32; Oliver King Sand and Gravel Co., $1.375; J. U. Burkhart, $1.40, and Otto Roehl, $1.50.

* * * * *

Syracuse, N. Y.—Oliver S. Cane, county purchasing agent, has signed contracts for delivery of 15,000 bbl. of Velo high-early-strength cement from the Glens Falls Portland Cement Co. at a price of $2.61 per bbl.

Purchase of the cement, which will be used on completion of the Caughdenoy road, was ordered by the board of supervisors at the last session, and Mr. Cane was authorized to make the contract without competitive bidding.

He got the lowest bid available, he said. The purchasing agent obtained a clause in the contract which protects the county in the event of any decline in price before the shipments are completed.—*Syracuse* (N. Y.) *Post-Standard.*

* * * * *

New York City—Since the first of the year five reductions in price have been made in New York City, the last being a 10c per bbl. reduction on March 30. Recently cuts were made in three different parts of the country—the Hudson river territory, where a reduction of 20c per bbl. went into effect, the Baltimore district and parts of Nebraska, Kansas, Iowa and Missouri.

In the scramble for the limited business placed in the past several months contracts have been closed at prices that show no profit to the manufacturer. In a number of instances involving large tonnages for road building and public works, states and municipalities, taking advantage of the demoralized market, have called for and rejected bids on the same projects several times, and have obtained lower prices on each new proposal.

Companies east of the Rocky Mountains, where more than 75% of the country's cement is used, are probably getting an average of around $1 per bbl. net in bulk at the mills, as compared with about $1.65 a year ago. The present price is considerably below the cost of production of the great majority of the mills of the country and in no case will yield anything like a fair profit.

The current quotation in New York City, for cement packed in paper containers and less all discounts, is $1.69 per bbl. As of January 1, last, the price was $1.94. In Albany the price is $1.73 per bbl. as compared with $2.08 at the beginning of the year, while in Chicago the quotation has declined to $1.40, from $1.86.

However, these prices are merely nominal. Any substantial contract probably would bring offers at lower figures.—*Wall Street* (N. Y.) *Journal.*

* * * * *

Mobile, Ala.—James H. Zelnicker of the Reliance Equipment Co. of this city announced recently the reduction in prices on many articles of building materials, a few of which are as follows:

Bank sand, per cubic yard, $1.50; sharp sand, per cubic yard, $2; gravel sand, per cubic yard, $3.50; Lone Star cement, per barrel, $2.75; lump lime, per barrel, $2.25; wall board, per 1000 ft., $28. All delivered to job.—*Mobile* (Ala.) *Press.*

* * * * *

Davenport, Ia.—The Dewey Portland Cement Co. has been awarded the contract to supply cement and crushed rock for the locks in the Mississippi river on which construction work is now being started.

Some 160,000 bbl. of cement and 125,000 tons of rock will be supplied by the Dewey concern, the total contract being for about $275,000.

News of All the Industry

Incorporations

Helderberg Crushed Stone Corp., New Scotland, N. Y., $5000. S. J. Daring, Albany, N. Y.

Vermiculite Co. of America, Wilmington, Del., 2500 shares common.

Enterprise Lime and Ballast Co., Wilmington, Del., $50,000; 500 shares common.

Campbell Stone Co., Afton, Mich., $200,000. To produce stone, lime, sand and gravel.

Penniman Concrete Pipe Co., Dallas, Tex., $30,000. Bruner R. Penniman.

John Kleist Sand and Gravel Co., Milwaukee, Wis., $25,000, consisting of 250 shares at $100 each. John F., George and Walter Kleist.

Richmond Sandgravel Co., Augusta, Ga. John G. Ehrlich, president, and John W. Wilson, vice-president.

Hudson County Crushed Stone Co., Inc., North Bergen, N. J., 100 shares common. Rexbaine Altschuler, Hackensack, N. J.

Pawling-Pawling Sand and Gravel Corp., 37 Wall St., New York City, 100 shares common. H. Greenwald.

Marion Gravel Co., Inc., Marion, Ind., 250 shares at $100 each. Frank L. Deer, Leon L. Deer, S. G. Cohen, L. A. Young and Walter Fudge.

Wabash Valley Asphalt Co., Inc., Terre Haute, Ind., 1000 shares of no par value. To produce asphalt paving material. Wm. L. White, Amanda White, John F. Kelly and Katherine J. Kelly.

Cinder Sales Corp., 305 W. Wacker Drive, Chicago, Ill., 100 shares of no par value. Charles J. Frenze, James W. Ryan and Frank F. Jucers. To deal in cinders, gravel, sand, etc.

Barton County Asphalt Rock Co., Iantha, Mo., 160 shares par value $100 each. Dr. J. E. Wicker, Mace Wicker and Joe S. Gill of Liberal, Mo., and S. B. Wicker of Westfield, Ind.

Hutchinson Sand and Gravel Co., Dalton, Mass., $60,000. Raymond G. Hutchinson, president; Ruth M. Hutchinson, vice-president, and Lucy M. Hutchinson, treasurer, all of Pittsfield, Mass. To produce sand, gravel and cement.

Perfection Stone Co., Sioux City, Ia., $50,000. Joseph Saur, president; Henry A. Meyer, vice-president; W. E. Michener, secretary and treasurer, and George H. Flynn and John Nills as directors. To produce cement products.

Morse Bros. Sand and Gravel Co., Rochester, Minn., $100,000, consisting of 1000 shares, par value $100 each. Charles Morse, Seth Morse, Elsie Morse and Clara Morse, all of Rochester, Minn. To produce and sell sand, gravel, and cement products.

Quarries

Hub Granite Quarry, Richfield, Wis., resumed work under new management April 15.

Adam Realty Co., Columbus, Ohio, will operate the dolomite stone plant at Cedarville, formerly operated by Carter N. Abel, Inc.

American Black Granite Co., Minneapolis, Minn., has installed a new rock crusher at the Mellen, Wis., quarry and rock crushing plant.

Thunder Bay Quarries Co., Alpena, Mich., has ordered six dump cars from the Koppel Industrial Car and Equipment Co.

Medina Sandstone Corp., Albany, Va., incorporated in March, 1930, has filed a certificate of voluntary dissolution.

Waterford, Ohio. The stone quarry company which has been operating on the Harold Pottmeyer farm moved to the Kaho farm April 16.

Lane county, Oregon, has moved its rock crusher to the Jack Small place near London, where it will be operated for the season.

W. C. Wallen and son and **George Rogers** have signed a contract to supply 18,000 tons of limestone to the American Beet Sugar Co. from the Wellsville quarry near Salida, Colo.

Wisconsin Granite Co., Redgranite, Wis., has put another hoist in operation. The first shipment of Milwaukee grout was made April 16 and it is now shipping eight carloads a day.

Dominion Rock, Ltd., Canada, a subsidiary of Montreal Quarry Co., Ltd., suffered the loss of one of its buildings through a fire. Damage totaled $25,000 and threw 50 men out of work for several days.

Hawkeye Quarry (Hawkeye Portland Cement Co.), Earlham, Ia., is installing a second track-shifting machine. The first machine was installed earlier in the spring and was so satisfactory that the second one was purchased.

Artstone Quarries, Inc., Crossville, Tenn., has changed its name to Crab Orchard Quarries, Inc., with an authorized capitalization of $50,000. It is said the change was made to eliminate confusion with an artificial stone company of similar name.

Kansas City Engineering Co., Kansas City, Mo., has been awarded the contract for crushed rock for surfacing Missouri route No. 4. A lease has been signed for the quarry on the Wayman farm, 4½ miles south of Princeton, Mo., to supply the rock for this work.

H. J. Miller of New Sharon, Ia., has taken a half interest in the lime and crushed rock pit being opened on the Verley farm six miles south of Grundy Center. A ten-year lease has been taken on the ground. A new crusher has been ordered and will be installed as soon as it arrives.

Richmond, Mo. The quarry located one-half mile south of Judge L. S. Magill's farm, three miles south of Dockery, Mo., will supply crushed stone on state highway No. 13. A stone crusher has been installed and other equipment is being added to produce sizes from ¼-in. to 1½-in.

Sand and Gravel

Bluestone Sand and Gravel Co., Seattle, Wash., is reducing capital stock from $100,000 to $50,000.

Iowa Falls Sand and Gravel Co., Iowa Falls, Ia., now has its new plant in full operation.

Consumers Gravel Co., New Orleans, La., opened a gravel pit on the C. L. Varnado place in South Franklinton recently.

Henry C. Ische, Milwaukee, Wis., has taken over the Hillside Sand and Gravel Co. at Prospect Hill and will conduct the plant under the name of Henry C. Ische at Hillside, Prospect Hill.

Richmond Sandgravel Co., Columbia, S. C., acquired 11½ acres of deposits and will construct a plant with a capacity of 20 cars of sand gravel per day. Production will start about May 1.

A. J. Gerlaugh, Osborn, Ohio, has purchased the rights of the Downey gravel pit and has reopened it. He will make delivery of aggregate with his own trucks.

West Virginia Sand and Gravel Co., Charleston, W. Va., has placed an order with the Midland Barge Co. for four standard sand and gravel barges for use on the Big Kanawha river.

Cass City Sand and Gravel Co., Cass City, Mich., has installed an Allswede scrubber in its plant. Other general repairs have been made to put its plant in readiness for the season's business.

Hart and Shaunghnessy, Auburn, Wash., are opening a gravel pit near the county game farm on the Stuck river. They are contracting with the city to supply water for two years to insure the city the cost of a meter.

Knoxville, Tenn.—Dredging operations are being pushed by a number of operators on the Tennessee river near here. The river is at a good stage for the movement of boats and full advantage of this situation is being taken.

Moville, Ia. The old S. S. Rundall gravel pit has been reopened after being closed for 20 years. Test pits sunk by R. E. Betz of Sioux City have shown good deposits. Chemical and physical tests have been conducted. Preliminary reports of these tests indicate the gravel is of excellent quality.

Lincoln Sand and Gravel Co., Lincoln, Ill., has started construction of a number of storage bins. It is also installing a large truck scale. When this installation is completed retail delivery of its products will be started. J. C. Johnston will handle this part of the company's business.

Alton, Ill.—To insure against trouble with stranded boats or barges at the plant of the Mississippi Lime and Material Co. that might result with continued low water, a dipper dredge is to be assigned to dredge out the harbor there. River engineers are looking forward to the lowest water in history on the Mississippi river this summer.

Ireland and Lester Sand and Gravel Co., Benton Harbor, Mich., is preparing the east end of the property between the St. Joseph river and Morrison channel outlet for a new depot. The company expects to dock the water front so that boats carrying stone and gravel can unload there. The channel will be deep enough so that the large boats can enter with their loads.

Lime

HiWay Lime Co., Pebble, Idaho, has started operation under new management to manufacture barreled quicklime and hydrated lime.

Standard Lime and Stone Co., Fond du Lac, Wis., recently lost 550 cords of wood in a fire at the Knowles plant. Enough wood was saved to continue operation one week, by which time it is believed a new supply may be obtained. It is said the loss was covered by insurance.

Gypsum

Gypsum, Lime and Alabastine, Ltd. (Canada), Paris, Ont., has received an order for the gypsum roof on the $175,000 reinforced concrete power house building of the department of railways and canals at Fort Churchill, Manitoba. Another contract on the books of the company is the gypsum tile order for a hospital extension in Winnipeg.

Cement

Portland Cement Association, Chicago, Ill., has moved its Los Angeles office to 1216 Architects' Bldg., Fifth and Figueroa Sts.

Tioga, Penn.—"Incor" cement was used to plug the Meaker well of the Penn-United Gas Co. when it "blew" recently at the rate of 40,000,000 cu. ft. per day.

International Portland Cement Co., Spokane, Wash., had an exhibit featuring its cement at a recent display of Spokane products exhibited to create interest in home construction.

Lehigh Portland Cement Co., Allentown, Penn., has resumed operation at the Union Bridge, Md., plant after a three-month shutdown. The power plant of the Fredonia, Kan., plant has been refitted and improved.

Kosmos Portland Cement Co., Kosmosdale, Ky., will contribute cash prizes to demonstration teams of the Kentucky 4-H Club when they hold their 11th annual Junior Week at the University of Kentucky in June.

Wyandotte Portland Cement Co., Detroit, Mich., was recently host to the Wyandotte, Mich., Exchange Club at its Wyandotte plant. H. A. Browne, superintendent, conducted the visitors through the plant and explained the process of manufacture to the club members.

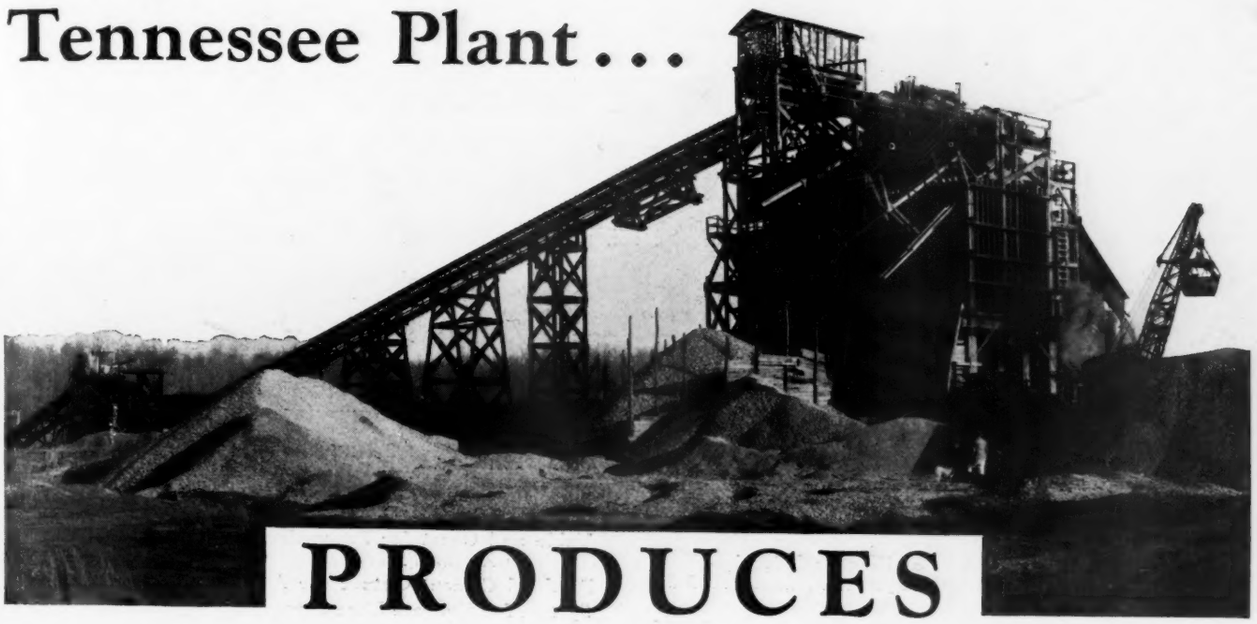
Dewey Portland Cement Co., Kansas City, Mo., was awarded contract for cement and crushed rock for the Mississippi river locks to be built at Davenport, Ia. It is said barges will be used to carry the materials from Dewey's Linwood, Ia., plant to the work.

Birmingham, Ala.—A tour of the Alpha Portland Cement Co., Lehigh Portland Cement Co. and Lone Star Cement Co. plants was made by the engineers attending the spring meeting of the American Society of Mechanical Engineers. Over 300 engineers were present at the meeting.

Oregon Portland Cement Co., Portland, Ore., is shipping 50,000 bbl. per month from its lime plant for the Owyhee irrigation project in eastern Oregon. While the capacity of the plant is only 35,000 bbl. a month at present, the company is drawing on a reserve to meet this demand, according to H. L. Knappenberger, sales manager of the company.

Alpha Portland Cement Co., Easton, Penn., elected the following board of directors at its annual meeting of stockholders held April 16: G. S. Brown, Easton, Penn.; C. K. Boettcher, Denver, Colo.; F. M. Coogan, Phillipsburg, Penn.; J. H. Lockart and J. M. Lockart, Pittsburgh, Penn.; F. G. McKelvy, Easton, Penn.; Robert Struthers, New York, N. Y., and Robert S. Gerstell, Easton, Penn. Mr. Gerstell was elected to fill the vacancy on the board caused by the death of C. A. Irvin of Chicago, Ill. The following officers were elected: President, G. S. Brown; vice-president, F. M. Coogan; vice-president, F. G. McKelvy; secretary, Robert S. Gerstell; treasurer, J. J. Matthes, Phillipsburg, Penn.; assistant secretary and assistant treasurer, W. E. Viets, Chicago, Ill.

This Tennessee Plant...



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